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Tool Grinding and Shaping Machine.

Wm. Sellers & Co., of Philadelphia, Pa., have now perfected a machine, of which we give an illustration, for grinding and shaping all the faces of almost any kind of lathe, planer, slotter, and shaper tools; in fact, we have yet to see the kiad of tool that this machine will not grind. We have seen tools brought direct from the blacksmith shop, placed in this machine, ground and shaped in a comparatively short time to an exactness which to obtain would require the best effort, and test the skill of an expert tool maker in a shop equipped only with an ordinary grindstone.

The construction of the machine is simple, and it is very easily handled by a man of ordinary intelligence. The main features of the machine are as follows: A grinding wheel is mounted in a cast-iron frame forming a large tank which receives the water used for flooding the tool in grinding. The machine is also provided with suitable shields which will prevent the throwing of water on the working parts of the machine, the floor or the operator. The water for flooding the tool is supplied by a brass rotary pump, which is driven by a round belt from the machine countershaft. It is provided with a jointed and counterbalanced nozzle, which may be set in any position required, to deliver the water on the tool to the best advantage. Slide rests are provided, by which a vertical and two horizontal motions at right angles to each other can be imparted to the tool-holding chuck. The slide rests and chuck are carried upon a vertical slide of square section placed in front of the wheel and working in a covered bearing, and counterbalanced by a massive spring, so that the vertical slide may be moved up and down by the long lever which is operated by the left hand of the attendant, the object of this movement being to move the tool in a vertical plane up and down past the grinding surface of the stone, and thus produce a plane surface on the tool. It is evident that if the tool were held at a convenient height and fed against the stone without other movement, the surface would conform to the surface of the stone, and as the bearing increased the cutting would become less rapid; hence, in grinding straight surfaces, the chuck and slide rest, etc., are moved vertically, as described, as well as horizontally. In grinding curved surfaces no vertical movement is given to the chuck holding the tool, but it is made to rotate to produce the curve desired. If the curve of the tool is not a circular one, but is such as shown in the diagram (page 2), then a "former plate" is required. Means are provided by which any sample tool, whether ground by hand or otherwise, can be used as a templet for grinding the "former plate" to be afterwards used for the reproduction of the shape of this sample tool. The preparation of necessary formers for a variety of peculiar curved shapes is not a matter of much expense, as these formers simply consist of small cast-iron plates $\frac{1}{4}$ of an inch thick, and quickly shaped in the machine.

The chuck which holds the tool can be rotated in two planes at right angles with each other, and the exact amount of rotation in either plane is indicated by graduated circles and verniers, so that any desired angle of tool or of clearance can be accurately obtained.

For grinding the curved face tools, the former plate is first selected as indicated by the table or diagram (page 2), and placed in the machine. Then the tool to be ground is placed in the swinging chuck with the base of the tool towards the left and pushed forward against the end gauge until the index-finger of this gauge points to the number given in the table plus the amount required to be ground off the tool, remembering that each graduation represents $\frac{1}{32}$" on the tool. Clamp the tool in the chuck; swing the chuck so that the entire curve of the tool will rub against the end gauge, note the oscillation of the index finger and adjust the chuck by means of the handle on the left, until these oscillations are reduced to a minimum. The tool will then be in the best position for grinding.

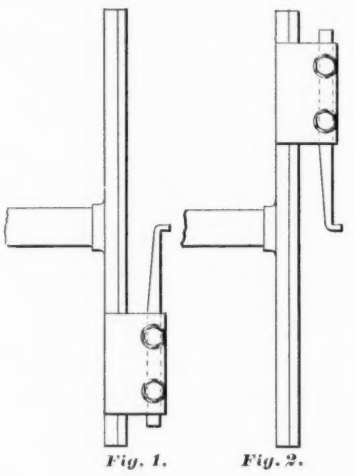


Fig. 1.

Fig. 2.

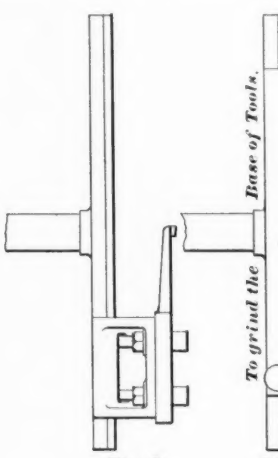
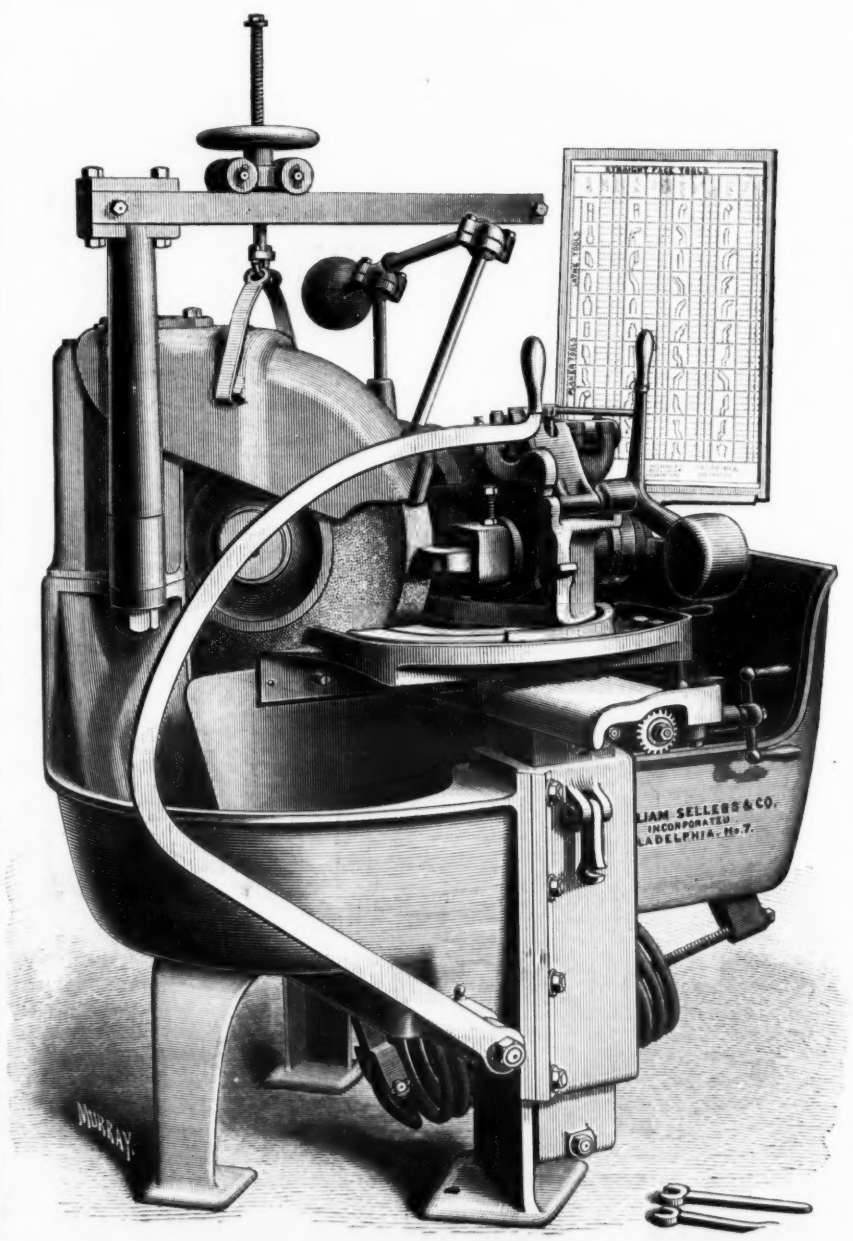


Fig. 3.

Fig. 4.



TOOL GRINDING AND SHAPING MACHINE.

A small crane is attached to the machine, by which the stone can be easily taken off its spindle or turned around when that becomes necessary. This crane is also useful and handy for lifting or taking out of the machine the supplementary chuck. We have no doubt as to the usefulness of this machine in any machine shop; it needs only to be seen to be appreciated.

For grinding lathe, boring and chasing tools, planer hook tools, and slotting splining tools, the supplementary chucks, as shown in Figs. 1, 2, 3 and 4, are used and set to the angles given for corresponding straight tools.

The periphery of the grinding wheel is not at right angles to the flat surfaces of wheel, but is formed so that in the section the grinding surfaces will form a V containing an angle of 90°. With this shape of stone a vertical surface perpendicular to the axis of the stone can be ground by moving horizontally the chuck with tool towards the center of wheel; then, without disturbing the tool or making any change whatever, a vertical surface at right angles to the former surface can be ground by moving the tool horizontally in a direction parallel to the axis of the wheel.

A diagram or table of which we only give a portion, on page 2, is furnished with this machine; the figures given in this table for the horizontal and vertical angles are those which have given the best results in the practice of Wm. Sellers & Co. These angles may be changed to suit the idea of others without interfering with the construction or principles of the machine.

Boiler Explosions in 1886.

We have received the following letter in reply to an article by Mr. Williams in a recent issue of the AMERICAN MACHINIST. Mr. Williams informs us that he obtained his figures from a paper which credited them to a publication called the *Safety Valve*. We presume the statement upon which Mr. Williams relied for statistics was incorrect, and are glad that Mr. Allen calls attention to the matter. Of course this in no way detracts from the value of Mr. Williams' argument:

Editor American Machinist:

In looking over the AMERICAN MACHINIST, issue of July 30th, 1887, I was much interested in an article by Mr. W. J. Williams on "Dicrotic Steam and Water Lines." The article is a good one, save probably in that of statistics. Do you know Mr. Williams' authority for the statement that "628 boiler explosions occurred in this country during the past year; the number of persons who lost their lives by these was 1,026, and 1,032 were injured etc., etc."? As you are no doubt aware, our company take special pains to obtain a record of all the explosions that occur in this country—a list of which may be found in the February number of each year (of the *Locomotive*). Referring to February, 1887, sent you herewith, you will find a record and classifica-

tion of the explosions during the year 1886. They were 185 in number*, and show 254 persons to have been killed and 214 injured.

The representatives of the company are in all parts of the country, and you may readily understand they are specially interested in gathering items of this character which they forward to home office. In addition to this we have the press dispatches, and a special disbursement to a news agency for items of explosions and the like. With all these sources of information we fear we occasionally miss a slight explosion in some remote part of the country, but we shall be greatly surprised if it can be shown by any trustworthy record that with all our resources for obtaining accurate information upon this specialty we have recorded less than thirty per cent. of those that happened.

Francis B. Allen,
S. G. A. Hartford Steam Boiler Inspection and Insurance Company.

Gas for Motive Power.

The report of the Brussels gas works for 1886 shows that the inducements offered to manufacturers to use gas as their motive power have not been successful, even where gas has been supplied at 2s. 3d. per 1,000 cubic feet. Receipts have fallen off since the introduction of the combined day and night meters, and the reduction of price, amounting to nearly 40 per cent., has only brought about an increase in consumption of about 5,000,000 cubic feet. The total day consumption for the past year was slightly over 10,000,000 cubic feet. This gives an average of about 300 cubic feet for each of the 115 gas engines in use in Brussels. It is not likely that the use of gas stoves will enable the lost ground to be made up, and the expansion of the use of gas by day is insufficient to compensate for the reduction of price. Moreover, a further reduction in price is demanded from the municipality, and it is considered likely that in a few years' time the gas works will have to sell lighting gas at 2s. 3d. per 1,000 feet.—*Engineer and Iron Trades Advertiser.*

The fact that several kinds of sewing machines can be bought much lower than when their manufacture was protected by patents is used as an argument against our patent system. The argument is exceedingly lame. It should be exactly reversed. As for example: The reason why sewing machines can now be bought so cheap is owing to the fact that our patent laws provided the inducement for inventors and manufacturers to study how to make good sewing machines for a little money. Some of these inventors and manufacturers got rich in doing this, which was a good thing. Without the protection of patent law it is probable that sewing would now be done in the good old way.

Why are rope belts used so extensively in England, and so little in this country? We are reminded of the difference in practice in this respect by noticing recent engravings of an English compound engine in place, upwards of thirty ropes being used in driving from the main pulley. The engine is a compound, with cylinders 32 and 60 inches, the stroke being 7 feet.

*185 explosions; 208 boilers exploded.

CURVED FACE TOOLS.

LATHE

Kind of Tool	a (size of tool)	To grind Curved Face: Horizontal Angle to give clearance	Former Plate	Indication of End Gauge	To grind Top Face: Symbol of Tool	Horizontal Angle	Vertical Angle	Symbol of Tool	Horizontal Angle	Vertical Angle
Roughing Tool CR / CL for Cast Iron	⅛″	98		4		93	114		93	66
	⅜″	98		6		92	113		92	67
	⅝″	98		8		92	111		92	69
	1″	98	A	11	CR	92	110	CL	92	70
	1¼″	98		14		92	110		92	70
	1½″	98		17		92	110		92	70
	2″	98		20		92	110		92	70
Roughing Tool CR / CL for Wrought Iron	½″	98		3		97	122		97	58
	⅝″	98		4		96	121		96	59
	⅞″	98		5		95	120		95	60
	1″	98	A	8	CR	94	116	CL	94	64
	1¼″	98		11		94	116		94	64
	1½″	98		14		94	116		94	64
	2″	98		17		94	116		94	64
Roughing Tool CR / CL for Steel	½″	98		4		95	118		95	62
	⅝″	98		5		94	117		94	63
	⅞″	98		6		94	115		94	65
	1″	98	A	9	CR	93	113	CL	93	67
	1¼″	98		12		93	113		93	67
	1½″	98		15		93	113		93	67
	2″	98		18		93	113		93	67

PLANER

Kind of Tool	a (size of tool)	To grind Curved Face: Horizontal Angle to give clearance	Former Plate	Indication of End Gauge	To grind Top Face: Symbol of Tool	Horizontal Angle	Vertical Angle	Symbol of Tool	Horizontal Angle	Vertical Angle
Roughing Tool AL / AR for Cast Iron	½″	95		4		100	71		100	109
	⅝″	95		7		100	71		100	109
	⅞″	95		11		100	71		100	109
	1″	95	A	15	AR	98	75	AL	98	105
	1¼″	95		17		98	75		98	105
	1½″	95		19		98	75		98	105
	2″	95		22		98	75		98	105
Roughing Tool EL / ER for Wrought Iron	½″	96		5		100	64		100	116
	⅝″	96		6		99	65		99	115
	⅞″	96		7		98	66		98	114
	1″	96	A	9	ER	98	66	EL	98	114
	1¼″	96		11		98	66		98	114
	1½″	96		13		98	66		98	114
	2″	96		15		98	66		98	114
Side Roughing Tool BL / BR for Cast Iron	½″	95		12		95	75		95	105
	⅝″	95		14		95	75		95	105
	⅞″	95		16		95	75		95	105
	1″	95	B	20	BR	95	75	BL	95	105
	1¼″	95		24		95	75		95	105
	1½″	95		28		95	75		95	105
	2″	95		32		95	75		95	105

STRAIGHT FACE TOOLS.

LATHE TOOLS.

Kind of Tool	Face	Angle of Clearance	Horizontal Angle on Grinding Machine	Vertical Angle on Grinding Machine
Finishing / Wrought Iron	Side a	4°	90	356
	Side b	4°	90	184
	End c	10°	80	90
	Top d	20°	110	95
Nicking	Side a	2°	90.3	358
	Side b	2°	90.3	182
	End c	10°	80	90
	Top d	0°	90	90
Side. / Right Hand	Side a	15°	90	345
	End c	2°	59.9	3.9
	Top d	12°	90	102
Bent Side. / Right Hand	Side a	12°	46.9	339.2
	End c	2°	75.2	182.2
	Top d	12°	98.5	98.5
Right Hand / Square Thread	Side a	11°	60.6	347.5
	Side b	5°	60.1	185.8
	End c	15°	75	90
	Top d	1°	91	90
Right Hand / 60° V Thread	Side a	8°	90	352
	Side b	0°	90	180
	End c	5°	85	90
	Top d	0°	90	90
Finishing	End c	4°	86	90
	Top d	7°	97	90
Finishing / Cast Iron	Side a	4°	90	356
	Side b	4°	90	184
	End c	7°	83	90
	Top d	12°	102	95
Bent Nicking / Right Hand	Side a	2°	45.3	357.2
	Side b	2°	135.3	182.8
	End c	10°	44.1	14
	Top d	0°	90	90
Side. / Left Hand	Side a	15°	90	195
	End c	2°	120.1	356.1
	Top d	12°	90	78
Left Hand / Bent Side.	Side a	15°	43.1	20.8
	End c	2°	75.2	357.8
	Top d	12°	98.4	81.5
Left Hand / 60° V Thread	Side a	5°	60	354.2
	Side b	11°	60.1	192.7
	End c	15°	75	90
	Top d	1°	91	90
Left Hand / Square Thread	Side a	0°	90	0
	Side b	8°	90	188
	End c	5°	85	90
	Top d	0°	90	90
Splining	Side a	2°	90.1	358
	Side b	2°	90.1	182
	End c	4°	86	90
	Top d	0°	90	90
Bent Finishing / Wrought Iron	Side a	4°	45	354
	Side b	4°	135	185.5
	End c	10°	44.1	14
	Top d	20°	107	80
Left Hand / Bent Nicking	Side a	2°	135.2	357.3
	Side b	2°	45	2.8
	End c	10°	135.9	346
	Top d	0°	90	90
Brass	Side a	14°	80	346
	Side b	6°	60	187
	End c	10°	75.9	45.6
	Top d	0°	90	90
Right Hand / Inside Bent	Side a	15°	133.1	339.2
	End c	2°	105.2	352
	Top d	12°	81.5	98.5
Right Hand / Y Thread	Side a	11°	108.5	322.8
	Side b	5°	105.1	185.4
	End c	15°	43	20.5
	Top d	1°	90.6	89.2
Right Hand / Square Thread	Side a	8°	45.6	348.7
	Side b	0°	135	180
	End c	5°	44.8	7
	Top d	0°	90	90
Cutting Down. / Left Hand	Side a	6°	90	354
	End c	4°	79.3	20.2
	Top d	0°	90	90
Bent Finishing / Cast Iron	Side a	4°	45	354
	Side b	4°	135	185.5
	End c	7°	44.5	9.7
	Top d	12°	98.4	81.4
Brass.	Side a	14°	80	346
	Side b	6°	80	186.1
	End c	10°	75.9	45.6
	Top d	0°	90	90
Brass. Bent	Side a	14°	52.7	156.7
	Side b	6°	104.9	186.2
	End c	10°	60.5	191.5
	Top d	0°	90	90
Inside Bent. / Left Hand	Side a	15°	133.1	200.8
	End c	2°	74.9	5.2
	Top d	12°	81.5	81.5
Left Hand 60° / Y Thread. Bent	Side a	5°	105.7	341
	Side b	11°	104.8	191.2
	End c	15°	43	20.5
	Top d	1°	90.6	89.2
Left Hand / Square Thread	Side a	0°	45	0
	Side b	8°	134.4	191.3
	End c	5°	44.8	7
	Top d	0°	90	90
Cutting Down. / Right Hand	Side a	6°	90	186
	End c	4°	100.8	341.2
	Top d	0°	90	90

PLANER TOOLS. Finishing — End c 4°, 86, 90; Top d 7°, 97, 90.

Circular Tools.

Horizontal Angle to give Clearance	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
Diameter. (d)	⅛	3/16	¼	5/16	⅜	7/16	½	9/16	⅝	11/16	¾	13/16	⅞	15/16	1	1 1/16	1 ⅛	1 3/16	1 ¼
Indication of End Gauge	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Former Plate	None.																		
Horizontal Angle to give Clearance	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
Diameter. (d)	1 3/16	1 7/16	1 ½	1 9/16	1 5/8	1 11/16	1 ¾	1 13/16	1 7/8	1 15/16	2	2 1/16	2 ⅛	2 3/16	2 ¼	2 5/16	2 ⅜	2 7/16	2 ½
Indication of End Gauge	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
Former Plate	None.																		

Diagram or Table for Tool Grinding and Shaping Machine.—See Page 1.

Cheap Steam Engines.

By W. H. Hoffman.

SECOND PAPER.

Perhaps it would have been fairer to the builder of the modern high-speed engine of small powers to have stated in the first paper, that the tests made by the writer in 1875 and 1876 were with engines mostly fitted wi h some variety of improved throttling governor. There were nine engines tested, six of which were regulated by governors of this type, while three of them had the old fly-ball governor and disk valve. I class them all as throttling governors as they varied the pressure by wire drawing the steam in a more or less extended degree.

One of the engines fitted with the old-fashioned governor and its attachments showed a fuel consumption of 7.37 pounds of coal per horse-power per hour, while another one with two disk valves, one placed at each end of the cylinder, showed 6.62 pounds as the hourly fuel consumption per horse-power. The other six engines had, as before stated, patent governors, two of them having a partial cut-off produced by a belt and cam combination; the other four wire drawing by various forms of governor valves and ports. The most economical of these showed 5.13 pounds, and the most extravagant one 5.6 pounds of coal per horse-power per hour, all the tests being based on an evaporation of 9 pounds of water with 1 pound of coal. These engines were all, with one or two exceptions, built as well as the average throttling governor engine of to-day. Those having two valves, one at each end of the cylinder, had but eight per cent. cylinder and port clearance, the governor valves being placed close to the main valves, and this combination gave very fair regulation, the variation of speed being about five per cent. I do not think, however, that the small throttling governor engine, now so plentiful in the market, can show any such economic results, as some of them have from 12 to 20 per cent. cylinder and port clearance, and the governor valves are not, as a rule, of the best class.

In making tests of an 8×12 engine, one of the electric companies found that at a piston speed of 450 feet per minute, the water consumption per horse-power per hour was from 60 to 72 pounds, and with another engine with cylinder 6×10 the water consumption averaged 68 pounds per horse-power per hour; the cylinder and port clearances in both cases was over 12 per cent.

Such results as the above do not reflect much credit on the builders of these

engines, as these performances are not much better, if any, than those of the numerous direct acting steam pumps, that follow full stroke, under a piston speed of not more than 175 feet per minute, and with no chance of a cut-off.

Now, on the other hand, the automatic high speed engine can be, and is, generally made with very small clearances, and the cut-off valves lay with only a thin thickness of metal between them, and the inner walls of the cylinder, and the movement of these valves is obtained directly from the main shaft in an instantaneous manner. There is no loss of time and no wire drawing, as the steam admission line is as near perfection as possible, often reaching a point within two per cent. of the boiler pressure, while the back pressure with 650 feet of piston speed can hardly be measured.

Another great advantage that the modern high speed automatic engine has over other types, is that it can use steam of very high pressures without damage to the details of its valves and valve motion.

It can use steam at 160 pounds, while the drop cut-off motions are troublesome at 100 pounds per square inch, and most of the builders of these valve gears prefer 75 to 85 pounds as the initial pressure, the disengaging latches and pins being quite durable under this pressure.

At the last meeting of the Master Mechanics' Association, held in June of this year, at St. Paul, a committee appointed by the association recommended the use of high steam and an early cut-off, and said: "The unsatisfactory results, however, obtained with the ordinary link motion from the wire drawing of steam, when cut off much earlier than at 25 per cent. of the stroke, point to the desirability of using some other type of valve motion when the extreme practice above referred to is contemplated." The extreme practice mentioned relates to fuel and water consumption, and the committee go so far as to recommend steam jacketed cylinders for locomotives, where economy is one of the chief objects. The record of the triple expansion engine, during the past two years, must satisfy most of our engineers that high pressure steam means power in one of its most compact forms.

The builder of the small, and cheap steam engine will soon have a very active competitor to meet, viz., electricity. As intimated in the first paper on this subject, he will find the "subtle fluid" soon carried in protected channels through all large cities, the motive power for this current being triple expansion steam engines, that will easily produce a horse-power with a consumption of less than $1\frac{3}{4}$ pounds of coal per hour. The electric companies can and will cover all cases of small powers, say from 1 to 17 horse-power, at this very low fuel consumption, within a short time, if we take the progress made in this new business within the last six months as our guide.

I have endeavored to place this matter before the users of small steam engines in a manner that will be thoroughly understood by them, and I believe if they demand a reasonable rate of economy in this class of engine, that they will get it, as the builders have as a rule adopted inferior designs in order to meet what the writer deems an unnecessarily sharp competition; the natural result being that there is little or no profit in the business for anyone concerned.

I do not see why the system of building the class of so-called cheap engines should not be changed, thereby placing in the hands of the selling agent an engine whose economic duty shall be far above the present one, and I think with all due respect to the builder of these engines that the time has come for a decided reformation in their construction.

Trials of English Engines.

Engineering contains quite lengthy and very interesting descriptions of exhibits at the Royal Agricultural Society's show at Newcastle-upon-Tyne. The results of brake trials of small engines is interesting. A non-compound Davey-Paxman engine, cylinder $9\frac{1}{2}'' \times 12''$, gave excellent results. Of this engine our contemporary says:

The engine, which is of the portable type without self-moving gear, has its cylinder well steam-jacketed over both barrel and covers, the jackets draining back into the boiler. The distribution of the steam is effected by an ordinary slide valve with an expansion slide at the back, this valve driving its motion from a link which is under the control of the governor. The link just mentioned has its ends coupled to two eccentrics giving the motion for late and early cut-offs (in fact complete suppression) respectively, and thus the position of the link controls the action of the cut-off valve. The governor is of the high-speed type—loaded partly by weight and partly by spring—which Mr. Paxman has used for some time past, and it is adjustable for speed without stopping the engine. The control given by it is excellent.

In the boiler of the engine the only notable feature is the fitting of the fire-box with eight Paxman water tubes, these tubes springing from the sides of the fire-box a short distance above the grate and curving upwards to the crown, their upper openings being fitted with deflectors to prevent the stream of water through them from being thrown up into the steam space. It may be remembered that the fire-box of the portable engine, with which Messrs. Davey, Paxman and Co. competed at Cardiff, was similarly fitted with water tubes. The boiler with the fire-box and tubes is throughout of a special quality of mild open-hearth steel, all plate edges being planed and all rivet holes drilled.

The feed-heating arrangements are very complete and effective. The feed-pump is of the continuous action pattern, the delivery being controlled by a by-pass; the water discharged by which becomes mixed with exhaust steam in the usual way before its return to the feed tub. On the other, the feed to the boiler, after leaving the pump, traverses a pipe which makes eight runs from end to end of a chamber filled with exhaust steam (the drainage from this chamber also returning to the feed tub), while, after being thus raised to some 200 degrees or so, the feed finally traverses a spiral coil of 1 inch pipe, so placed in the smoke-box as to be fully exposed to the escaping gases. * * * The engine was worked during the trial at 105 pounds pressure, driving 17 horse-power on the brake, and it accomplished its task with a consumption of 2.52 pounds of coal per brake horse-power per hour, a performance which ultimately secured for it the first prize in its class. That this result was largely due to the admirable stoking of Mr. Paxman is undoubted, but apart from this the engine is undoubtedly of excellent design generally.

The same firm exhibited a compound engine, cylinders $5\frac{3}{4}$ inches, and $9\frac{1}{4}$ inches diameter, 14-inch stroke, which, making 140 revolutions per minute, 150 lbs. boiler pressure, is credited with delivering a brake horse-power on 1.8 lb. of coal, doing 20 horse-power of work, the water supplied to the boiler being 17.76 lbs. per brake horse-power. *Engineering* says:

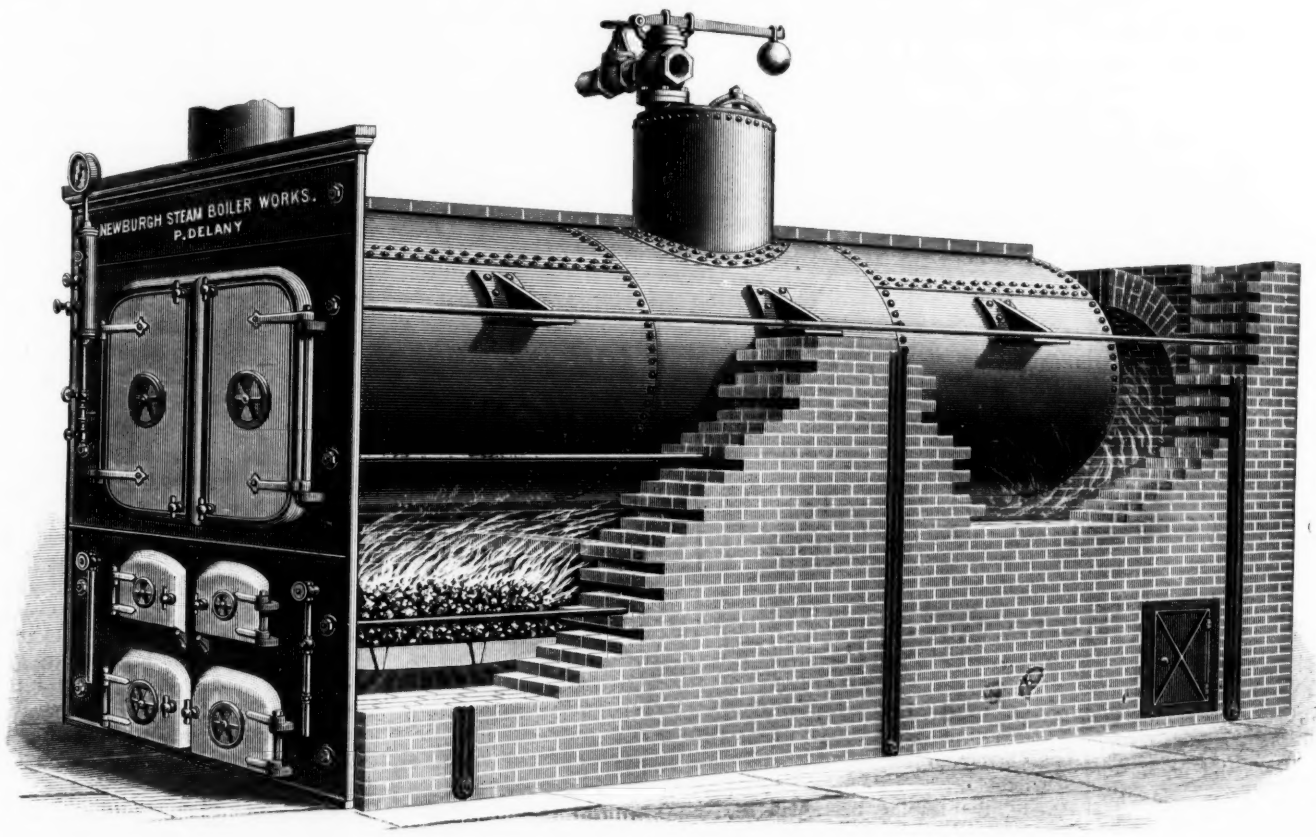
Friday, the 8th inst., was devoted entirely to trials of compounds, the first to be started being the compound portable by Messrs. Davey, Paxman & Co., of Colchester. A high performance was expected of this engine by those interested in the trials, and the "prophets" were not disappointed, the engine beating all previous records, and securing its makers the £200 prize offered for its class. * * *

Messrs. Davey, Paxman & Co.'s compound differed materially from their non-compound engine, it being really an independent engine with side frames of channel section mounted on the top of a locomotive boiler. The cylinders are very completely steam-jacketed, the jackets being arranged to drain into the boiler through suitable connecting pipes. The low-pressure cylinder has a single slide, while the high-pressure cylinder has slide with a cut-off valve on the back, the action of this valve being controlled by the governor in the same manner as in the firm's single-cylinder engine already described. The crank-shaft is provided with a central bearing. The arrangement of feed-heater is the same as in the maker's non-compound engine. The boiler is of mild steel throughout, and the fire-box casing has a flush top instead of being raised, as in the non-compound; as in the case of the latter engine, all rivet holes are drilled and the boiler is hydraulic riveted. The fire-box is without any water circulating tubes.

The total heating surface of the boiler supplying steam to the compound engine was $224\frac{1}{2}$ square feet; grate surface 4.62 square feet.

Petroleum Fuel.

The Wood River Branch Railroad, which has had some trouble from wood fires set by sparks from its locomotives, is now making extensive experiments like those in progress upon the Pennsylvania Railroad, looking to the substitution of petroleum for coal as fuel. The locomotive Wincheck has been equipped with ingeniously arranged appliances of pipes and valves leading to two huge burners, so placed as to deliver huge streams of fire through the furnace door. A jet of steam is turned through the combination pipes, the injector forces a supply of oil from a tank in the tender through a gauge contrivance where it mingles with the steam to form a gas which makes a powerful and intense heat. It is believed by the officials of the road that this device will generate all the steam the engine needs and do away with smoke and cinders. A trial on Friday showed that steam was quickly raised, but was not held under draught or load. Another burner will be added to the two in use. The invention is put in by the New York Gas and Smoke Consuming Company. The result of the arrangement is looked forward to with a good deal of interest. Another method is being tested at the Hinkley Locomotive Works, Boston, with a condemned Boston and Providence engine. In this method, the invention of Mr. B. A. Moody, of Dedham, the crude petroleum is conducted from the tank in the tender to a peculiar burner in the fire-box. Through a semi-circular slot, one-sixteenth of an inch across, the fuel flows out on a flat table about the shape of an ordinary palm-leaf fan. At the apex of this table, and just above the entering point of the petroleum, is the outlet of another pipe which leads from the boiler of the locomotive. The steam at a boiler pressure of 150 pounds is passed through a Mason valve, reducing the pressure to forty pounds. At this pressure it sweeps across the flat table on which the petroleum is flowing and forms a fine spray which is forced through the interstices of a large pile of fire-brick in the fire-box. The heat a few minutes after lighting the spray becomes intense, and it is claimed that a higher temperature can be thus obtained than by the consumption of coal in a locomotive fire-box.—*Providence Journal.*



Horizontal Tubular Boiler.

Horizontal Tubular Boiler.

The engraving represents the practice of the Newburgh Steam Boiler Works (P. Delany), Newburgh, N. Y. The courses are made of single steel plates, with longitudinal seam, double riveted, and above the fire. The tubes are spaced one inch apart, horizontally and vertically, except at the center vertical rows, where the space is two inches. No tube is nearer the shell than three inches, with nine inches space at the bottom. A handhole plate is located in each head.

The fixtures furnished with these boilers are: heavy cast-iron front, with double flue, furnace and ash-pit doors and linings; arch plates; front, middle (where grates are in two lengths) and back grate-bar bearers; grate-bars; ash-door and frame, with bolts; lug plates and friction rollers; brick stays; anchor and brick stay bolts and nuts; safety valve; steam gauge; glass water gauge; gauge cocks; water column; blow-off, feed and check valves.

Practical Drawing.

By J. G. A. Meyer.

THIRTIETH PAPER.

REPRESENTATION OF HIDDEN PARTS.

303. All edges and elements of curved surfaces which are seen when looking at an object, must be represented by full lines. Edges or elements which cannot be seen, or we may say, edges or elements which are hidden by other surfaces or objects, are represented by lines, made up of short dashes and spaces, the dashes being about double the length of the spaces, as shown at *A*, Fig. 214. These lines are called dotted lines. It is always advisable to show only the hidden edges and elements which are absolutely necessary for a representation which will not leave any doubt as to the exact form in all the details of the object shown. Take for instance Figs. 202 and 203; if the dotted lines *g h* and *i j* in Fig. 202 had been omitted, then it would be impossible to determine whether the inner square $g_2\ i_2\ k\ l$, in Fig. 203, represent a recess or a hole straight through the prism. Again, had we omitted the dotted lines *e g* and *f h* in Fig. 206, which represent two elements of the inner surface of the hollow cylinder, then it would be impossible to determine whether the inner circle $e_2\ f_2$, in Fig. 207 represents a recess or a hole straight through the cylinder. Here then we see that in cases of this kind the representations of the hidden surfaces are absolutely necessary, and without these dotted lines the representations or projections of these objects would not be complete. But in machine drawing, cases often occur in which the representation of the hidden parts will not add to the value of the drawing or aid us in the conception of the form of the things shown, and therefore such hidden parts should not be represented. Omitting to show the hidden parts not necessary for conveying our idea of form, will save considerable labor and also add to the distinctness of the drawing; too many dotted lines create confusion.

304. All lines which make up the outline of an object, including both the full and dotted lines, must always be drawn with black ink.

DIMENSION LINES AND CENTER LINES.

305. The dimension line is one having for its purpose the indication of the distances between any two parts, lines and points on the drawing. These dimension lines are terminated at each end by an arrow head, as shown at *B*, Fig. 214, and on these lines between the arrow heads, wherever convenient, the dimensions in figures are written. The center line is a line about which the parts of an object are symmetrically arranged. It is often necessary to show on the drawing the center lines; indeed, frequently these center lines are the first lines drawn, so that about these, other objects or parts of objects may be symmetrically placed.

In order to enable any one to distinguish on a paper drawing the dimension lines and center lines from the outline of an object, these lines, instead of being drawn with black ink, are drawn with a different colored ink; among draftsmen carmine seems to be the favored color for the dimension and center lines. If the same colored ink is used for both the center lines and the dimension lines, then generally the former are represented by full lines, and the latter by dotted lines, so that the dimension and the center lines can be readily distinguished from each other. Some draftsmen make a distinction between these lines by using carmine for the center lines and Prussian blue for the dimension lines; but this latter method requires too much time and trouble in changing the ink in the pen, and therefore it is not often adopted. The writer would recommend to use carmine for the dimension and center lines, dotting the former, and using a full line for the latter. But here a difficulty arises; in late years blue prints have been and are extensively used, and no doubt will be as extensively used in the future. Now, since in a blue print all the lines are white, and since we cannot call to our aid different colored ink for making a distinction between certain lines, we must establish some other method by which the outline, center line, and dimension line can be distinguished from each other. Unfortunately, among draftsmen there is no uniformity in the manner of representing the dimension and center lines, or, in other words, there is not a standard form of dimension and center lines. But a standard is necessary, and the writer believes that a better standard cannot be adopted than that which has been established in the Sibley College; this standard the writer recommends, and will be adopted throughout these papers. It is this: All dimension lines are made up of alternate long and short dashes, as shown at *B*, Fig. 214; all center lines are made up of alternate long, and two short dashes, as shown at *C*, Fig. 214. Lines similar to those shown at *B* and *C* are called broken lines.

306. We will also remark here, that in making the tracing from which the blue print is to be taken, many draftsmen, probably the majority, use black ink for all the lines; some draftsmen use black ink only for the outline, and carmine (red ink) for the dimension and center lines. In the writer's opinion the use of red ink for dimension and center lines has its advantages, namely, the tracing itself will be plainer and easier to read than when all the lines are drawn with black ink; and again in the blue print taken from such a tracing the dimension and center lines will be somewhat fainter, or not so bright as the outline of the object, and this result adds to the distinctness of the blue print. Of course, when, in the tracing, carmine is used for the dimension and center line, the standard form of these lines, as shown in Fig. 214, must not be changed.

Fig. 214

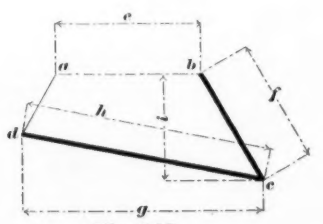


Fig. 216

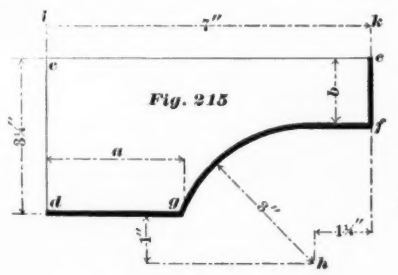


Fig. 215

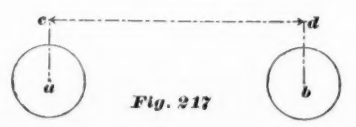


Fig. 217

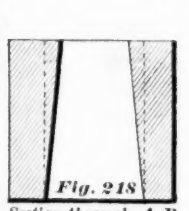


Fig. 218
Section through *A B*

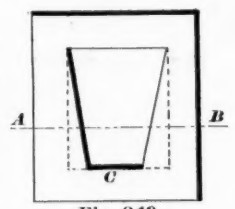


Fig. 219

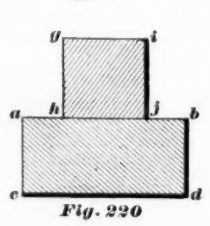


Fig. 220

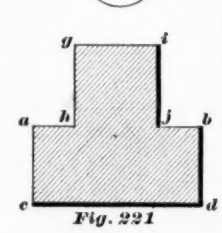


Fig. 221

POSITION OF THE DIMENSION LINES ON A DRAWING.

307. Drawings which are to meet the requirements of a workshop must have all the dimensions of the object represented, clearly defined by figures; drawings on which the length, breadth and thickness only are given in figures are not satisfactory; the radii, position of the centers from which arcs are drawn must be defined by figures written on dimension lines, the latter judiciously placed on the drawing; in fact, all drawings, whether full size or not, should be such that a workman can at once obtain all the sizes necessary for shaping the material, without placing a rule or a scale on the drawing.

All dimension lines should be placed or arranged in a manner which will not interfere with the clearness of the outline of an object or ruin the distinctness of the drawing; good judgment is often necessary to do this successfully.

The dimension lines may be placed outside the outline of an object, as shown in Fig. 215, or they may be placed inside; when many objects are shown close together, or one behind another, then frequently the position of the dimension line will not be a matter of choice, but a matter of good judgment, so that the clearness of the drawing is preserved. In Fig. 215 we have also shown the manner of indicating the position of the center with the length of the radius given in figures for the arc drawn. If the position of the center of this arc is of greater importance than the distances from *d* to *g* and from *e* to *f*, then the position of the center *h* must be given; if the distances from *d* to *g* and from *e* to *f* are of greatest importance, then mark the dimensions in figures in place of the letters *a* and *b*, also the radius as shown, but leave out the figures and dimension lines which indicate the position of the center *h*; if the position of the center *h* is as important as any other dimension, then define by figures all the sizes as well as the position of the center; indeed, the latter method is often pursued by draftsmen, even when some of the dimensions are not so important as others, because this will enable them to test the correctness of the figures by addition, subtraction, multiplication or division, as the case may require. In fact, it must be remembered that in writing the figures upon the drawing the scale alone must not be depended upon, the distances must be measured with the scale and correctness of the figures established by calculation; in this manner the figures will be a check on the scale, and the scale a check on the figures. No rule for placing the dimension lines can be given, but the following suggestions may serve as a guide.

308. All the dimension lines must be drawn in, or parallel to the direction in which the distance is to be measured, thus: In Fig. 215 the dimension line on which is written the length of the line *c e*, is drawn parallel to the line *c e*; it would be wrong to draw this dimension line in an oblique position to that of the line *c e* with the intention of giving the length of that line. Take for example Fig. 216; if here we wish to give the length of the line *d c* we must draw the dimension line *h* parallel to *d c*; if we simply wish to give the horizontal distance between the ends of the line or the points *d* and *c*, then the dimension line *g* on which the distance is to be given by figures must be drawn in a horizontal direction. In a similar manner the dimension line *f* with a figure upon it will define length of the line *b c*, and the vertical dimension line *i* with a figure upon it will define the vertical distance between the points *b* and *c*.

309. If the dimensions are given outside of the outline of an object, as shown in Fig. 215, then the length of the dimension line is limited by terminating lines, thus: The dimension line, on which the figure 7 is written, is limited by the terminating lines *c i* and *e k*. Terminating lines must always be drawn perpendicular to the dimension lines.

310. If the distance between two points or two centers of circles is to be given, as that between the points *a* and *b* in Fig. 217, then the dimension line must be drawn parallel to an assumed line through the given points, and the terminating lines *a c* and *b d* drawn through the points *a* and *b* perpendicular to the dimension line; the arrow heads on the dimension lines must just touch the terminating lines.

SECTION LINING.

311. It often happens that parts of a machine, work, or are concealed in, some other part of the same machine; for instance, in a steam engine the slide valve is concealed in the steam chest, the piston in the cylinder, etc. Often, too, the interior of a casting may be composed of chambers, passages, etc.; a steam engine cylinder is a sample of this kind. Now, when it is desirable to show some hidden part of a machine, we often assume that the part of a machine which conceals things is cut in two pieces, one of these removed, the remaining piece shown on the drawing, and the hidden mechanism exposed.

312. When a section of any object is to be shown, we present it in a manner that the surfaces formed by cutting an object in two pieces are seen, and in order to distinguish such surfaces from bounding surfaces we draw across the former surfaces lines close together, all making an angle of 45 degrees with a horizontal or vertical line.

Fig. 219 represents a plan of a hollow casting. The line *A B* represents the edge of a plane which cuts the casting in two pieces. And Fig. 218 represents a vertical section of the casting, with the piece marked *C* removed. The surfaces over which the oblique lines are drawn are the surfaces formed by cutting the object with the plane *A B*. The lines which make up the oblique lining shown in Fig. 218 are called "section lines." The section lines should always be drawn at an angle of 45 degrees to a horizontal line, which, through custom, is recognized to be correct. Section lines forming other angles with a horizontal line may lead to doubt as to what is meant. Hence, in section lining, always use the set square containing the angles of 45 degrees, such as illustrated in Fig. 49.

When the section is not made through the center of an object, then the position of the cutting plane must be given on the drawing, and designated by letters. Thus, writing the remark "Section through *A B*," under the sectional view in Fig. 218, indicates that the object has been cut by a vertical plane passing through the line *A B*, shown in Fig. 219.

313. But other advantages are gained by showing a section of an object. First: we may show at once by the section the nature of the material. On paper drawings it is customary to indicate cast-iron by drawing the section lines with black ink; wrought-iron is indicated by drawing the section lines with Prussian blue, and brass with carmine water color.

In blue prints all the lines will be white; hence we cannot call to our aid different-colored ink to show the nature of the material; and therefore, for this purpose, some other standard system of section lining must be adopted.

314. The system which we shall adopt in these papers, and which we recommend to the student, is that established at the Sibley College, and illustrated in the American Machinist, April 9, 1887. Further explanation in connection with these illustrations is unnecessary.

315. Another advantage gained by showing objects in section is that sometimes the form and shape of objects can be definitely shown in section, which could not otherwise be done without making explanatory remarks. Thus:

In article 287 it is stated that Figs. 204 and 205 are not quite satisfactory, because, with these figures before us, it cannot be determined whether one or two things are shown. But now, if Fig. 204 had been a sectional view, as shown in Fig. 220, then we would at once conclude that two prisms, one standing on the other, are represented.

because the line *a b*, being drawn across the figure, indicates a joint, and this, in connection with the section lining, being in opposite directions, indicates that two separate pieces are shown. If, on the other hand, a section, as shown in Fig. 221, had been given, in place of Fig. 204, then we would know that the outline of only one solid is represented, because there is no line from *h* to *i*; consequently no joint is indicated, and again the section lining is all in one direction.

Thirty-Inch by Thirty-Inch by Eight Foot Planer.

We illustrate herewith a planer made from entirely new designs by the Powell Planer Company, Worcester, Mass. It will be observed that the bed is of more than usual depth, and the uprights have sufficient metal and width of base to withstand the strain of tool in cutting.

The table is wide, all slots in it are planed and the pin holes are drilled and reamed. It is driven by two belts, through a train of cut gears and rack.

The driving gears are all enclosed in the bed, and protected from chips; they are mounted on steel shafts of large diameter, having long journals.

The improved belt shifter transfers one belt before the other by a positive motion; the arrangement is such that the table can be stopped without shifting the over-head belt, and can be run back to examine work without shifting a dog.

The feed is automatic in all directions; and is adjusted by a screw, and operated by a vertical rack.

The slide on the head can be run up or down by the handle on either end of the cross-feed rod. Sliding fits are carefully hand-scraped to surface plates.

Hardening Steel Pieces.

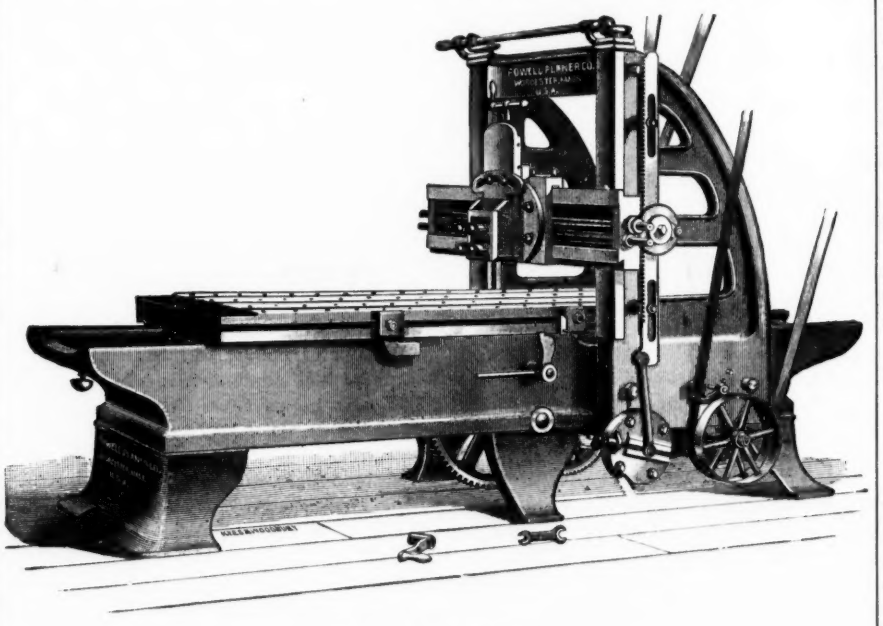
The following communication to *Mechanical Progress* (published at London) is from John W. Newall, a London engineer and manufacturer. It is of interest in relation to a question of a good deal of importance:

"I have lately been making a few experiments in hardening steel, the results of which you may be interested to know. It is a very old truth which I have been 'discovering;' but, somehow, people won't believe in it till it is forced on them by necessity. I had some long pieces of steel to harden all over. A plain, straight section—no irregularity of thickness; it ought to have been a simple job; but, do what I would, a large proportion of them came out crooked, especially in the larger sizes. I took every precaution I could, rough-turned them, annealed them, fine-turned them, and then hardened them. Still they came crooked. Then I tried to straighten a crooked one. Everyone had always told me, 'It all depends on how you did it.' So I dipped them in every conceivable way—endways, flatways, sloping, quickly, slowly. But, practically, it made no difference in the straightness. I quite satisfied myself that whether or not the mode of dipping made things crooked, once crooked, no manner of dipping would straighten them. Then I said to myself, 'If they don't go crooked in the water, it must be in the fire.' Why? Obviously for one of two reasons: either because they did not lie flat on a supporting surface, or else because they were not treated evenly. Now I had been treating them in a special furnace, the heat in which seemed to the eye quite even. Also, a man who seemed to know what he was talking about, had lately been writing in the American Machinist (you should read that regularly; you will get lots of hints from it) that steel bent very easily at certain temperatures. So I bedded it carefully on sand, so that it was fairly supported throughout its length; but the bar was as crooked as before. Finally I left it moving the whole time, so that the heating was quite even. I wasn't particular as to its bed, and I wasn't over particular as to how I dipped it; but that one, and all others after, came out straight. Of course it is not conclusive for all sections; but for even sections I think I am justified in saying that steel will keep its shape, if in heating to harden it be heated evenly. I don't mean that at time of dipping only it should be of an even heat, but that each increment of heat from first to last should be evenly distributed."

Blind Drivers—An Engineer's Suggestion.

By John A. Hill.

In these latter days of heavy locomotives for the greater part of our freight service, the third, fourth, and in a few cases the fifth driver has been added to our engines. It was found necessary to do this, in order to distribute the extra weight, and not have to make axles as big as a propeller shaft, and many other similar and equally good reasons. But the big consolidation engine could not get its long wheel base around a curve of even moderate "crook," if all the wheels under the boiler were flanged, and so the flange was left off half the wheels; and for the same reason it is left off on one pair of drivers on the ten-wheeler, and the mogul, and the six-wheeled switch engines. Now these blind drivers have a wider tire than the flanged wheel, to allow them to follow Josh Billings' advice, and "slosh 'round a little," while the flanges on the other wheels keep them in due bounds. If all railroad tracks were straight, blind drivers might have flanges; but they are not, and so



Thirty-Inch Planer.

thousands of these monsters are prowling around over the country half-shod, so to speak. I have been running one and another of these thousand-legged worms over the heavy grades and crooked tracks of the Rocky Mountains for some years, and have watched their antics somewhat closely. These engines slip badly on very crooked track, and a great deal worse when new, or with a newly turned tire, than when a year or more old. This was one of the mysteries to me, until I got to thinking about it; and while I am on the subject, I believe that "thinking about it" is the morning sun that obliterates many a will-o'-the-wisp mystery.

When a locomotive is new, the tires are straight on the face, and the lateral motion is all taken up by the hubs of the drivers, fitting close to the outsides of the driving boxes. When this engine strikes a curve, her front trucks and forward driver with a flange pull her around; and the following drivers, without flanges, work over the inside of the curve; and the moment she gets those blind drivers out of their regular rut—so to speak—away she goes, unless the runner is there with his sand.

I never saw a blind driver in my life that did not have a nice ring of thick grease all around on the face of those blind drivers, except when the wheel came in contact with the rail in its normal condition. Oil as carefully as you please, it will come; wipe it off you cannot, and it gathers dust, and grasshoppers, and ashes, and more grease, till it is a sort of soap, as slippery as John Fink's methods, and twice as slippery as his compound. This grease gets there by centrifugal action, being thrown out by the revolution of the wheel, and comes from the driving box and cellar. It is too tenacious, and in too small quantities to fly off at the rim, but works around to face of the wheel. On the driver with a flange it goes to the edge of the flange, but cannot work back toward the center of the wheel; so it accumulates until there is weight enough to fly off, and it flies. If it will fly off one flange, it will from another; and if we have got to have blind drivers, what is the matter with having blind flanges? If the tires had a groove cut into their faces, near the back, as below, this would act as a flange to throw off the accumulated filth.

(A small flange could be cast on the spider of the wheel; but this would be expensive, in the way, and require new wheels.) The groove, one-half inch deep, and as wide, or a little wider, would do the business, I am sure. It would not cost anything to speak of, and in no way injure or interfere with the other objects of the blind driver.

I wish some master mechanic would try this, and let us know how it works. When an engine is old, there is a groove worn into the tire, by the rail, that is hard to get it out of, and, there being considerable side-motion in the boxes, the engine will round any ordinary curve, without getting to the grease spot. Perhaps keeping the engines worn out is a way out of the trouble; and, as it is so much in use, perhaps my suggestions are superfluous.

The Bulletin sometimes brings to light unpalatable truths, of which the following is one. It does good service, however, in giving them publicity. What we need most to know is the weak places; the strong ones will take care of themselves:

Boston is building a new court house, the iron beams for which come from Antwerp. The contract price is $68,023, and the difference between this and the best American bid for an equal grade of iron was several thousand dollars. The same court house is being supplied with 155,000 Gladstone brick of unusual size, made in Wales. The price to be paid delivered is $45.50 a thousand. About 20,000 have already arrived. The taxpayers who foot the bills for Welsh brick and Belgian beams may well ask the question whether Boston is an American city.

Closer relations with Mexico should lead our manufacturers to study the needs of that country in the way of machinery more than they have done. Mexico in the way of natural advantages is a particularly favored country, and her interests are, in a great degree, the same as those of this country.

LETTERS FROM PRACTICAL MEN.

U. S. S. Nuts.

Editor American Machinist:

In your answer to question No. 318, giving sizes of U. S. S. nuts, you say the size for rough nuts is once and a-half the size of the bolt, plus one-eighth of an inch, and for finished nuts, once and a-half, plus one-sixteenth of an inch.

In this you are wrong. While the Franklin Institute standard gives the two sizes of nuts, and while a few of the leading Philadelphia firms still use the two, the Government engineers have had the good sense to use one size, and save the bother of a double set of wrenches.*

Those who have tried it find it a great convenience to make the bolt heads and heads of cap screws the size of nuts one size smaller. That is to say, the head of a three-fourth bolt or cap screw is the same as a standard five-eighth inch nut. This makes a head large enough for use; one that looks well, and with a single set of wrenches one always has a five-eighth inch wrench to hold the head of a three-fourth inch bolt, and a three-fourth inch wrench to operate the nut, and the same with other sizes.

J. G. Tramis.

[Strictly speaking, our correspondent is right. The Navy Department makes the sizes of finished nuts the same as that of rough nuts, viz., the larger size given, and call this size U. S. S. But the writer's experience in ordering nuts and bolts U. S. S. from manufacturers has always been that the finished nuts are smaller than the unfinished by the amount of stock required to finish them. If this practice of manufacturers has been reformed we shall be glad to record it, or if any competent body has established sizes different from those of the Franklin Institute, and these sizes are adhered to by manufacturers, we shall be glad to make it known. We supposed the party who asked the question wanted to know the common practice, and answered him to the best of our knowledge, and after considerable investigation of the subject, with a view to finding out what would be furnished at the present time by manufacturers on a call for U. S. S.]

Saw-Mill Boilers.

Editor American Machinist:

I have been interested in the various articles on boiler explosions that have appeared in your columns from time to time, and especially in those on saw-mill boilers, and would like to state a few facts that have come under my observation, which I think will help to solve the problem of saw-mill boiler explosions. It is my belief that, whenever there is a leak in a boiler, or the fire-box of a boiler, the alkali formed thereon and about the leak, by the combination of the wood ashes from the fire and the water, eats the iron very rapidly. I was running an engine and boiler in a basket factory where a good deal of the refuse wood was used as fuel. There were three leaks in the fire-box, two at the end of the tubes, and one on the side, about two or three inches above the level of the fire, the other two being a foot above the fire, or about fifteen inches from grates.

Every morning and night I noticed that the tube ends, or, in other words, ends of the flues and the flue sheet, were covered with a coating of wood ashes, for a distance of about fourteen inches from the leak. This coating averaged about a quarter of an inch thick. Every time I blew out, which was once a month only, I wiped these ashes off, and found that whenever the ashes had adhered to the iron, it was pitted and grooved. I knew it could not have been the water, as it was "pure pond," and the barrel of the boiler was in good condition inside. I wiped the ashes off the side, and found the iron, for a distance of about eight or ten inches from the leak, the same

* So that the U. S. S. standard and the Franklin Institute standard are not one and the same thing so far as the outside diameter of nuts is concerned.

in appearance as the flue sheet, but in worse condition, the pits and grooves being much larger and deeper, and from all appearances pretty nearly through the iron, which is $\frac{3}{8}$" or $\frac{7}{16}$" in thickness. I immediately notified my employers of the matter, who said: "Those leaks have been there for a long time now, and have never done any damage, and I guess they will last for a while longer, anyway." I had just previously heard, through one of the oldest employes of the firm, that the smoke-box, through which the exhaust was carried, had been replaced only twice in three years, as it had been "rotted out," as they termed it, and it was almost ready to be replaced again.

Failing to get necessary repairs done, I looked elsewhere for a job.

This experience did not satisfy me, however, so I began to investigate matters a little. I went to several saw-mills and wood working shops and found five out of six had leaky boilers—some to a dangerous extent—and no engineers. These boilers were in the same condition and using different water; nearly all used wood and shavings exclusively for fuel. One was a horizontal tubular boiler which had a leak just in front of the bridgewall and about half way up the side from the center. I went there Sunday, when all was cold, and wiped off the ashes which were on and around the hole for a distance of eight or ten inches. The iron was pitted and had a crumbly appearance: that is, it looked as though the iron had been pounded and had jarred the small particles out.

The ashes on this boiler were only $\frac{1}{8}$" or $\frac{3}{16}$" thick. I examined five or six others and found that when the leaks were anywhere in range of the fire they were invariably covered with ashes and fine dust.

It can safely be said that two-thirds of the saw-mills, in this State at least, have their safety valves overloaded to a very dangerous extent or no valves at all, and as the men in charge are thoroughly incompetent to run a steam boiler and are required to run some other machine in connection with their engine and boiler, the steam is allowed to run up to a dangerous pressure, and of course these parts that have been weakened by this process I have just mentioned give out under the strain.

Owners of saw-mills, that is the majority of them, do not do a very rushing business, and consequently do not feel like sending forty or fifty miles for a boilermaker, to put on a patch, as long as their feed pump is in good condition, so the boilers are allowed to run just as long as they will hold together. Sometimes not quite so long, as we often see.

I can cite instances where mills were running with engineers and a farmer boy came along and offered to do the work for from 25 to 50 cents less a day, and the engineer had to make room for him. The great evil with saw-mills is cheap labor for skilled work.

H. H. K.

Willoughby, Ohio.

Three-Legged Machinery.

Editor American Machinist:

I notice in your issue of July 30 some comments on three-legged machines. The three-legged idea is doubtless as old as the advent of machinery, perhaps older. Adam and his better half used a three-legged milking stool, for aught we know. But the idea of swiveling a pair of legs to one end of a machine for the sake of making the three-legged idea appear fashionable is not quite as old, probably. Some thirty-five years ago the swiveling plan, as mentioned by Mr. Sweet, was practically carried out in one instance at least, and, of course, it answered the purpose of a three-legged machine, but the machine had such an unstable look of useless complication that it was decided that such machines could never become popular as an article of manufacture, and that the only way to make a success of a three-legged lathe or planer would be to fix all of the legs firmly to the body, as shown in the sketch in your issue of July 16.

As to the idea of upsetting a three-legged machine easily, let the reader test this, even with the small size lathe or planer; it will take but a few minutes, and he will find the upsetting objection vanishing into thin air. He will find the three-legged machine abundantly stable for all practical use.

Hence the essence of the comments in the issue of the 30th is simply this: "A three-legged machine is out of fashion and won't sell." Of course we all know that superficials govern, that fashion influences our action far more than solid reason, and I notice that some engineers, architects, and mechanics are not exempt from this weakness.

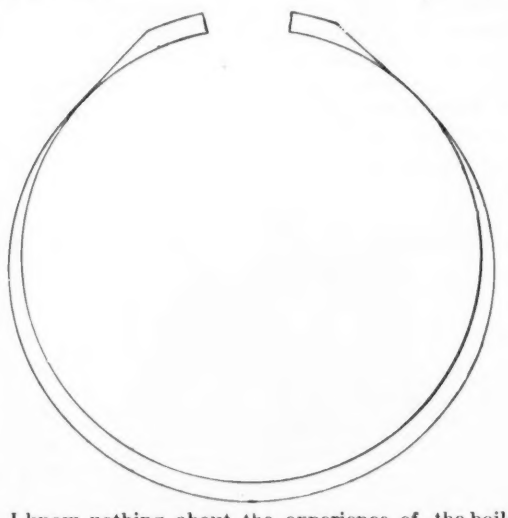
F. G. Woodward.

The Ramsbottom Packing Ring.

Editor American Machinist:

I suppose it is in order for me to notice Mr. George Robert Ray's not very courteous letter in your last issue, in which he undertakes to correct my *misstatements*.

The Ramsbottom rings used by me in England were purchased from Peter R. Jackson, Salford, who was the sole maker. The material was wrought-iron. The rings wore generally somewhat in the manner represented in the sketch below. The wear is shown on one side, continued till the ring is worn in two.



I know nothing about the experience of others, but everybody who is acquainted with the English people knows that if anything of this kind is put on the market with the backing of an influential name they will continue to use it right along, however it works.

I make another statement, which perhaps Mr. Ray may see fit to correct. I have substituted in place of the Ramsbottom ring in my practice for many years cast-iron rings bored eccentric, the thin side about half the thickness of the other, and cut at the thinnest point. These have worn admirably, though it was generally found desirable to ease the points a little.

Now comes the demonstration, showing that to obtain an exactly uniform expansive action in such a ring, the opposite extreme depths or thicknesses should be about three to one. I regard it as a very valuable contribution to engineering constructive science.

Chas. T. Porter.

Schenectady, N. Y.

Baldwin Locomotive Works.

From the first day of January to the first day of July this year, the Baldwin Locomotive Works have turned out three hundred and nineteen locomotives. We believe this record cannot be beaten by any locomotive works in Europe.

The hot wave has been getting in its work in England in the way of buckling railway rails screwed up too tightly at the joint. If we can take statements literally the divergence from a straight line has, in some cases, been as much as nine inches.

The French steamship Champagne has beaten the record by making the voyage from Havre in seven days. Allowing for distance, this beats the records of both the Umbria and the Etruria.

Boiler Feed Pumps.

A LECTURE DELIVERED BY FRANK H. POND, M. E., BEFORE THE BROTHERHOOD OF STATIONARY ENGINEERS OF ST. LOUIS, MO.

The boiler feed pump was not used until about 1780. The earliest written account of mechanism in which heat is made to perform work by means of steam, is contained in the work entitled "Pneumatics," written by Hero, a philosopher of Alexandria, about 130 years before the Christian era. The instrument described for the production of rotary motion is one of great ingenuity, and has all the qualities of a true and efficient steam engine, except in size. These engines are more expensive in the use of steam than ordinary engines, and travel at an inconvenient speed; but in other respects they are quite as effectual, and their construction is extremely simple and inexpensive.

This engine is often called "Hero's engine," and the construction is described by him as follows: "Let a boiler be set on the fire and nearly filled with water, and let its mouth be closed by a cover which is pierced by a bent tube whose extremity fits exactly into a hollow sphere; but at the opposite end of the diameter (of the sphere) let there be an iron axis supported from the top of the cover, and let the sphere have two bent pipes at the ends of a diameter of the sphere, perforated therewith and bent round in opposite directions; and let the bends make right angles and be in the plane perpendicular to the axis. Then it will follow that the boiler being heated, the vapor passing through the tubes into the sphere will rush out through the reversed pipes, and whirl the sphere round on its axis."

It is very evident that when the water in the boiler has all been converted into steam, the sphere will cease to revolve and the boiler must be allowed to cool, be re-filled and the water converted into steam before the sphere will commence revolving again.

The next improvement in the manner of feeding boilers which is of interest to us, is in connection with Savery's engine, on which he obtained a patent in 1698. This is, properly speaking, a "water elevator." A brief description of this apparatus may not be out of place.

Steam from the boiler is admitted into a chamber to expel the air; the valve to the boiler is then closed and water is run into the chamber, and the steam is condensed, making a partial vacuum, into which the water from the well is driven. Steam is again admitted to the chamber from the boiler forcing the water out and up into an elevated tank. Savery used two boilers, one larger than the other.

Steam for the engine is drawn out of the larger boiler. A pipe connecting the two boilers is run from the top of the larger through the top of the smaller boiler, and extends down within eight inches of the bottom of the smaller boiler. There is a check-valve in this pipe opening towards the larger boiler. The operation is as follows: Both boilers are filled with water to the proper height; a fire is built under the larger boiler, and steam is generated in it and used in the engine until the water is lowered to a level that needs replenishing. Then fire is made under the smaller boiler, all outlets from it being closed, except that which connects with the larger boiler; the pressure of the steam increases until it exceeds the pressure in the larger boiler, when the check-valve raises and the water passes from the smaller into the larger boiler, until the water is lowered in the smaller boiler down to the end of the connecting pipe. Cold water is then run into the smaller boiler from a tank, elevated to a sufficient height to overcome the pressure of steam, thus reducing the pressure in the boiler by condensation; the check-valve at the same time closes the connection with the larger boiler. The smaller boiler again being filled to the proper height, it is in a condition to replenish the larger boiler. Thus, the steam could be generated continuously in the larger boiler, the height of water in either boiler being determined by gauge cocks. This arrangement worked very well. It must be remembered that the steam pressure used at this time was little more than that of the atmosphere.

The first successful engine that was operated by means of a cylinder and piston was invented by Thomas Newcomen, about 1710. It was single acting, the steam raising the piston, and the atmosphere forcing it down, when a vacuum is formed by condensing the steam below the piston. He also used a walking beam. The pressure of steam in his boiler was balanced by a column of water, which also answered as a means of feeding the boiler with water.

Brindley, in 1718, added a float in the boiler, arranged to regulate the admission of feed-water to the water column.

The improvements of Smeaton (1767) were chiefly in the greater care of construction of the engines, and a better proportion and arrangement of the boiler, without applying any new principle to their construction. The steam engine, as it left the hands of Smeaton, was a mere pump, extravagant in use of fuel; even when used to raise water it could only be employed to advantage when the cost of coal was small.

The transformation of this rude machine into the modern steam engine was the work of James Watt, and certainly history can furnish no other example of so magnificent an improvement having been achieved by a single individual. Watt's inventions were all important and complete, and the description of them would be so interesting that we do not like to pass them over without a brief notice; but his inventions were principally confined to the steam engine, and it would, of course, be foreign to our paper to enter into a detailed description of them.

Watt invented the boiler feed-pump and applied it to his engines about 1780, it being operated from the walking beam taking water from the hot well and forcing it into the boiler, thus keeping up a continuous supply while the engine is in operation.

As the steam boiler became extensively introduced it was found necessary to have a feed-pump independent of the engine, for in many cases it was not advantageous to have the pump connected directly with the engine, and often no engine was used. The independent direct-acting boiler feed-pump is an American invention, and was introduced about 1840. The steam cylinder of this pump was supplied with steam through a pipe which had a valve at the other end within the boiler. This valve was controlled by a float, which, by its rising or falling, supplied more or less steam and allowed the pump to run faster or slower, according to the height of the water in the boiler.

The slide-valve, controlling the admission of steam to the cylinder, was acted upon by a spring compressed by the action of the pump so that it remained at rest, until at the proper time, when, by the further motion of the pump, the spring was released, and moved the valve. This was the beginning of the numerous class of inventions that followed for storing power to act upon the steam valve. In some, an application was made by the force of gravity, the moving piston being caused to lift a weight, which, passing a neutral point or center, at the instant of piston stoppage, acted on the valve. The momentum of the piston was also applied as the force to move the steam admission valve. The general principle involved in the construction of the independent feed pump is the combination of a pump with the steam cylinder that drives it by direct action without the intervention of a crank, fly-wheel or any other device for producing rotary motion. The construction of the earliest form of independent feed-pump is as follows: The steam cylinder was similar in all respects to that of an ordinary high

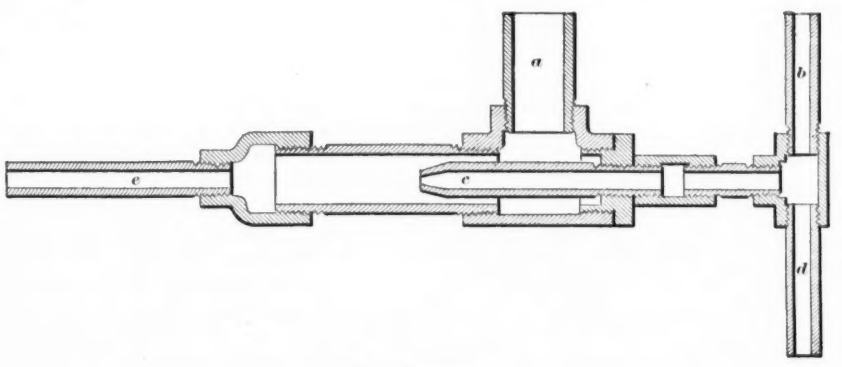
pressure engine, with the parts as usually constructed for the admission and emission of the steam. The piston rod was prolonged and attached to the water plunger of a double acting pump. The tappet arm was fastened to the middle of the piston-rod, and the tappets on the rod were struck at each end of the stroke, in order to change the position of the steam valve and admit steam to alternate sides of the piston. The steam valve was prevented from stopping directly over the ports, and excluding the steam from either end of the cylinder, by a peculiar arrangement of the water passages in the pump, so that the resistance was reduced or relieved at or near the end of the stroke, and thus a momentum was suddenly generated, amply sufficient to throw the valve wide open. This plan was simple and effective. The next step taken in the improvement of the direct acting steam pump was to act on the main steam valve by means of a secondary or sub-cylinder and piston, to which steam was admitted by a sub-valve actuated by the main piston at the end of the stroke. This is the plan now most extensively used, the numerous variations and modifications of which have not changed its general character. As this form of valve motion is in such general use, it may be of interest to explain its action more in detail. It must be very evident that if the main steam valve derives its movement solely from the piston, that when this valve reaches the center of its stroke, in which position the ports leading to the main cylinder would be closed, no steam could enter the cylinder to act on the piston, and the pump must consequently come to a rest, because its momentum would not be sufficient to keep it in motion, and the main valve would remain in its central position or "dead center." To shift this main steam valve from its central position and admit steam in front of the main piston (whereby the motion of the piston is reversed and its action continued) some agent, independent of the main piston, must be used. This agent is a supplemental or valve-driving piston. This supplemental piston consists of two piston heads connected together and working in independent cylinders at each end of the valve chamber.

The main valve, which controls the admission of steam to and the escape of steam from the main steam cylinder, is divided into two parts. The lower part is connected directly to the valve rod, which derives its motion from the steam piston, and slides upon a seat on the main steam cylinder, and at the same time affords a seat for the upper part of the valve, which derives its motion from the supplemental piston, and slides upon the upper face of the lower part of the main steam valve. Their operation is as follows: We will suppose the piston is moving towards the left. The lower part of the main valve, which has three ports through it, corresponding with the ports in the steam cylinder, will be at the right-hand end of the steam chest. The upper part of the valve, which is a plain D valve, is at the left-hand end of the steam chest, covering the left-hand port and center port of the lower valve. When thus arranged, steam is admitted into the cylinder through the right-hand port, driving the piston towards the left, while the exhaust steam passes out through the left-hand port in the lower part of the valve, under the upper part of the valve, and through the center port of the lower valve into the atmosphere, the supplemental piston being situated at the left-hand of the steam chest. There are also two ports connecting with the end of each cylinder, in which the supplemental pistons move.

As the steam piston reaches the left-hand end of the cylinder, the outside valve motion connected with the piston rod moves the valve rod and lower part of the main steam valve to the left. This movement of the lower part of the main steam valve opens the port connecting with the left-hand cylinder of the supplemental piston, admitting steam behind it, and forces it from left to right, carrying with it the upper part of the main steam valve, thus uncovering the left-hand port in the lower part of the main valve, which admits steam to the left-hand end of the cylinder, reversing the motion of the pump, and driving the piston from left to right. Operations similar to those already described will follow when the piston approaches the right-hand end of the cylinder. By this simple arrangement the pump is rendered positive in its action; that is, it will instantly start, and continue working, the moment steam is admitted into the steam chest.

We also have the feed-pump built on the general principle of the rotative steam engine, with a crank and fly-wheel, and an eccentric to operate the valve, or a fly-wheel with yoke arrangement to control the movement of the piston and valve.

Single direct-acting pumps may be divided into two classes: pumps with outside valve gear, or those having some of the moving parts which act to operate the valve outside the cylinder, and pumps having their valve gear inside, no moving parts being visible when the pump is in operation, except the piston rod. It has been shown that no direct-acting steam pump can reverse its motion without the use of a supplemental piston to move the main steam valve in a direction opposite to that of the piston, but where two direct-acting pumps are placed side by side, and move in opposite directions, and the steam valve of one pump is connected directly with the piston of the other, it simplifies the arrangement, and a plain D valve can be used without the use of any supplemental piston in the steam chest.



Tar Burner.

Hence, the duplex pump is essentially two direct-acting pumps placed side by side, their valve motions being so arranged that the motion of one pump acts to give steam to the other, after which it finishes its own stroke and waits for its valve to be acted upon before it can renew its motion. The crank and fly-wheel pump and the belt pump form separate classes. The principle of the action of a pump is as follows: Supposing the piston to be at the end of its stroke, as it moves away from the cylinder head a partial vacuum is formed in the pump cylinder, more or less complete, according to the perfection of the working parts and tightness of the joints in the suction pipe. The suction valves will be forced upward by the water rising into the pump, which is forced up into the space between the cylinder head and the receding piston, by the pressure of the air on the exposed surface of the water in the well; in other words, by removing the pressure of the air from that portion of the water covered by the suction pipe, that portion is forced upwards by the pressure on the remaining portion of its surface. On the return stroke, the suction valves close, and discharge valves open, and the water is forced out of the pump.

It is easily understood that the height to which the water above the discharge valves can be raised is only limited by the power with which the piston is moved, but the height to which the water under the discharge valves can be raised above the natural level of the water in the well is limited by the law of nature to about 34 feet; that is, if a perfect vacuum could be produced in the pump cylinder, the level of the bottom of the discharge valve could not be more than 34 feet above the surface of the water in the well.

There appears to be a belief by many who operate pumps that the water is drawn into a pump by means of what is called "suction." There is no such thing as "suction" to a pump, as we have already shown. It therefore follows that the suction pipe should be larger than the delivery pipe, because friction is overcome in the suction pipe by the atmospheric pressure only.

In single-boiler feed-pumps the suction pipe is usually made about one-half the area of the piston, and should be increased in size if it is very long, and also be provided with a foot valve. The delivery pipe is usually made about one-third the area of the piston. If the suction pipe is very long, there should be a vacuum chamber placed on it as near the pump as possible. The advantages of the vacuum chamber on the suction pipe are as follows: In a single direct-acting pump the flow of water into it is started and stopped at each stroke, and, of course, produces a shock on the pipe and valves; the longer the suction pipe is, the greater the shock. To relieve this shock a vacuum chamber is placed on the suction pipe. Theoretically, if we could produce a perfect vacuum in the suction pipe, three would be no air in the vacuum chamber to act as a cushion to receive the shock caused by the stoppage of the flow of water, and the water would simply rise in it, but practically we never produce a perfect vacuum in the suction pipe, and hence there always is some air in the vacuum chamber, which becomes expanded, and its elastic force prevents the shock and causes the water to flow uniformly into the pump cylinder, insuring its being properly filled at each stroke. The vacuum chamber should be at least twice the capacity of the pump cylinder.

An air chamber should be placed on the delivery pipe to prevent the shock and insure a uniform discharge, and should have a capacity of from three to four times the capacity of the pump cylinder.

With duplex pumps the air and vacuum chambers need not be as large, because the flow is more uniform, but we think they are an advantage with a long suction pipe, and with heavy pressures or long delivery pipes on any style of pump.

The most important part of a pump is its valves. The pump may be of good design in other respects, but its performance will be seriously affected if the valves are of an unsuitable type, or bad in workmanship and design. A great portion of the power lost in a pump is largely due to these defects. The duty of a pump valve is twofold. First: it should afford an unobstructed passage of the water. Second: it should close the passage entirely, and prevent any return of water in the contrary direction. The flat disk valves generally used in boiler feed-pumps are made of soft rubber, hard rubber, and brass. Soft rubber is used for cold water, as it makes a closer joint on the seat, thus reducing the slip to a minimum. Hard rubber and brass valves are used with hot water. We prefer hard rubber, as it requires no grinding, and where there is sediment in the water, the valve always wears out, never the seat, which is an important consideration; for with the brass valve both the seat and the valve are worn away in grinding the valve in, and unless done by an expert the valves leak more after they are ground than they did before.

As water expands by heating, a pump that would be large enough to furnish a given quantity of cold water would not be of sufficient capacity if the water was heated. In pumping hot water it is always best to have the supply above the pump.

Many writers give as a rule for the capacity of a boiler feed-pump, that it should be of sufficient size to deliver one cubic foot or 7½ gallons of water per hour, per horse-power developed by the engine, when running at slow speed. With the use of modern non-condensing steam engines that will develop a horse-power on a consumption of less than 30 lbs. of water per hour, per horse-power, or about one-half a cubic foot, we think it is unnecessary to provide for such a large capacity. We generally allow 4 gallons, or 33.2 lbs. of water per horse-power, per hour, where an automatic engine is used, and 6 gallons, or 49.8 lbs. of water per hour, per horse-power, where a slide valve engine is used. This amount of water being delivered at about one-half the number of strokes given in the tables of capacities in the pump trade publications, or say at a piston speed of about 50 feet per minute.

As all the tables give the capacity of a pump per minute, and as the horse-power is calculated upon the consumption of water per hour, our short rule for general practice is, to divide the horse-power to be developed by ten, which gives the proper capacity of a boiler feed-pump at a piston speed of 50 (fifty) feet per minute.

A Tar Burner.

By Frank H. Treacy.

The use of crude oil as a fuel agent has been tried, in various ways, with varying success for years. A recent article announcing the success of a new burner in use on a locomotive on the Penn. R. R. reminded me of a successful experiment made by my brother in the Poughkeepsie Gas Works, of which he is manager. Being unable to dispose of the gas tar at a profitable figure, he decided to burn it in the retort furnaces in place of coke, and after a number of experiments constructed a simple burner which operated successfully. The sectional cut shows the construction of the burner, which, by the way, was made entirely of ordinary iron pipe and fittings. The ¾″ pipe *a* was connected to a tank which was about 10 feet above the burner; in this case the tank was on top of the bench of retorts. A globe valve was put on the pipe *a* between the tank and the burner, at a convenient point, for the purpose of regulating the flow of tar to the burner. The pipe *b*, diameter ¼ inch, was connected to a boiler from which the steam supply was drawn. Pipe *d* was used to draw off the water of condensation when starting the burner. One end of the steam pipe *c* was closed from ¼″ to ⅛″ in diameter, thereby forming a nozzle, as shown in cut.

The discharge pipe *e* was ¼″ diameter and 18″ in length, and was put through the brick front of the bench at a point about midway between the furnace bars and the bottoms of the lower retorts. A block of fire brick was placed at the rear end of the furnace to protect the back wall from the direct action of the flame, the heat of which was intense. The space in the furnace below the burner was nearly filled up with coke dust.

To obtain the best results it was found necessary to have at the boiler a steam pressure of not less than 40 pounds, and that the steam should be as dry as possible. The tar was run through a fine netting, to remove any dirt which might stop up the space around the steam pipe *c*. The consumption of tar with this burner running continuously for twenty-four hours, connected to a bench of five retorts, no other fuel being used, was 2½ barrels. During the above time the retorts were charged every four hours, and 6,000 pounds of coal were carbonized. The same work would require about 40 bushels of coke when the tar burner was not used.

After being once properly regulated, and the tar and steam supply were kept constant the burner required no more attention than a good injector. The combustion was so perfect no smoke could be observed escaping from the chimney.

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The Fuel Question.

Just now the most absorbing question in many localities in this country has relation to the probabilities of finding natural gas. The gas fever of the present day bears a striking resemblance to the oil fever of twenty-five years ago. Companies are being formed to bore for gas in most places where there is reasonable prospect of finding it, and in many places where the probabilities are very remote.

If half the accounts published about great finds of natural gas were true it might be expected that an entire revolution in the fuel problem was imminent. But while gas may have been found everywhere that it is reported to have been, a great many have learned by unpleasant experience that it did not pay to find it. Striking gas that flows at a light pressure, oozes out, so to speak, is an unprofitable experience that has aggravated a good many searches. But occurrences of this kind are heralded by the press and multiplied in the imagination. In this way many places get the reputation of being blessed with gas fuel, when in reality enough gas will never be brought to the surface to do them any good, or much harm, except the loss of a few thousand dollars in fruitless endeavors to bring about the impossible. The places where natural gas is found so as to be of any great value are much fewer than is popularly believed.

While there is economy in the use of natural gas compared with coal, the difference in cost is not so great as is generally represented. The difference is mainly in the greater convenience of the gas, greater cleanliness, and economy of room. In some places the price of gas is yet kept low, but as the piping for and distribution of gas is fast getting into the hands of large companies, there is, reasoning from analogy, every reason to believe that the cost to consumers will be mainly governed by the price of coal. But even then the matter of convenience will make it a favorite fuel for many purposes, and will doubtless excite inventors to devise better means of making cheap gas from coal; this, it is believed by many, will be in a few years the favorite fuel when large quantities are used.

In the meantime there is no reason for manufacturers who are situated so as to get cheap coal to contemplate the extinction of their business through the competition of natural gas. With such abundance of coal, so easily brought to the surface, the fuel question in this country will take care of itself for some thousands of years to come.

Learning a Trade.

The *Jewelers' Journal* argues—we think wisely—in favor of boys learning a trade in the shop. It says:

When a boy has once gained the practical knowledge which every boy of the least ability will naturally acquire in a shop, he is fitted to convert the knowledge which a college or university course offers him into useful wisdom.

The greatest fallacy of modern educationalists is that a boy can better be taught to do something by theory than he can learn to do something by practice. This has never proved true, and there is no reason to believe that it ever will. There are thousands of college graduates in this country to-day whose prospects of getting a living are extremely precarious, because they know nothing except what they were taught at college. On the other hand, there are a great many who have had their ideas broadened by a college course, and are correspondingly benefited thereby. Simple as the whole matter is, there are many who cannot be made to see it, and they are helped along sometimes, in their blindness, by those who ought to know better. The idea that a college course alone will fit a man to get a decent living is as fallacious as the idea that such a course cannot be made to help him in getting along in the world. The best advice, in our opinion, that can be given boys in this respect is: Do not depend upon what you may acquire at some institution of learning to get you comfortably through the world. The failures will be a hundred to one. On the contrary, do not despise what you may learn at schools and colleges. This will be a mistake, though not so fatal as the one first named.

We have no faith in the idea that appears to be gaining ground, and which is seriously set forth by some very intelligent people, that a man may have too much school education; that it may unfit him for duties where he is not required to use it. Upon this theory a man who shoveled gravel for a living ought not to have any education to speak of. We believe it would be a good thing if he had a college education—of the right kind. His feelings would not be seriously hurt by his occupation, if he saw others, as well educated, doing the same kind of work. His school education might not assist him in his work; but it could be made a source of pleasure, and the probabilities are that he would be a better citizen than if densely ignorant. Nor have we any faith in the opinions frequently set forth of late, that a man can have so much special education as to warp his mind to such an extent that he cannot go on in investigation, in the same line, beyond or outside what he has learned, whereas without this education he would have been able to have done so. In other words, that special education may so stultify a man as to prevent his reaching, as an investigator in the same line, the position he would have reached without this education! A sufficient reply to this argument is that when a man's education is not of the kind that learns to discredit a thing to-day that he accepted yesterday, then his education is defective in one very important respect. It would be safe to go so much farther than this as to say that, if a man would not do this in spite of educational influences, he is not made of the right stuff for an investigator.

But aside from the undoubted advantages of school education—technical, for instance, for a mechanic—we believe that the place for a boy to learn to forge iron and steel is in the smith's shop, and the place to learn to do the work of fitting and putting them together as machines and machinery is in the machine shop.

Gerard B. Allen.

Gerard B. Allen, one of the oldest and most prominent citizens of St Louis, died unexpectedly at Richfield Springs, N. Y., recently. Mr. Allen was the founder and president of the Fulton Iron Works, of St. Louis, and the president of the *Missouri Republican* newspaper, and was identified with the most important building, commercial, and social enterprises of St. Louis. From the time of its organization to the present he had been president of the St. Louis Commercial Club. We recognize his name as that of one of our earliest subscribers.

The proposition of Prof. Vose, of Massachusetts, that the State shall take the matter of bridge inspection in hand—railroad as well as every other kind of bridge—is a good one, but it will by no means cover all that is desirable. The Professor says: "Nothing but perpetual inspection by the very best of experts, backed up by a judicious method of informing the public from time to time just how safe the bridges are, will prevent these terrible disasters." The weak point here is that no kind of inspection short of demolition will show the condition of an iron or steel bridge after years of service. All the experts in the world could not, in any other way, tell "just how safe" such bridges are, or were. The deterioration of iron or steel subjected to jar and concussion, as in the instance of bridges, is something that almost literally nothing is known about: no inspection practicable will reveal it. It is better to comprehend this fact in the beginning than to cultivate a false feeling of security based upon untenable grounds. The only way to obtain reasonable security is to condemn all the material of steel or iron bridges after a certain interval, depending upon the conditions of use, just as railroad companies condemn car axles after a specified mileage. Prof. Vose's plan would undoubtedly prevent much criminal practice in the neglect of bridges, and in using them in service they were never intended for, and to that extent would serve a good purpose.

Power and Work.

One of the most frequent questions we are asked to answer is: "Which takes the most power?" followed by a statement of the conditions. These questions, when the varied conditions relate to friction, are not always easy to answer, but when the changed conditions are such that the final results are changed, then they can generally be readily answered, provided the results are plainly indicated.

Take the question recently asked, in substance: Does it require as much power to drive a fan when the blast is shut off as when it is open?

Only this need he considered: In which case is there the most work done? If that can be answered, then we have the answer as to which takes the most power, for we cannot do the work without paying for it.

Another case often brought up, and about as often decided and proven wrong (by stopping too quick or beginning too late) is this: Which takes the most water to lock, a light boat or a heavy one? The true reply is reached when it is considered in which case the most work is done. The law holds good in this as in all other questions of its class.

One of the best examples called to mind was the testing of a Bradley hammer by an Emerson dynamometer. When set running with the hammer striking the anvil it took perhaps one-half horse-power, but when a bar of red-hot iron was being worked the power required was three or four times greater, although the blows were less frequent, the hammer head raised a much less distance, and the noise appeared to indicate less work. But the indications were deceptive. The work was being done when the iron was being forged, and the law held good; it took power to do it. The hammer striking the anvil bounds to nearly the height it falls from, and so takes but a small amount of power to keep up the motion. In forging the iron there is no bounding—no recoil.

In the verification of a large majority of our known facts, the fact is first discovered, then disputed, then proved, and then the reasons, previously overlooked, are traced out, and the fact (which is no more a fact than it was at first) is called a scientific fact.

Those who have strong faith in the possibilities of electricity have been telling us that our street cars can be propelled by its use at about half the present cost. It would be a good thing if they would "show their faith by their works." New York city is a good place to practice on, and we wish them abundant success. As we have said before this, the spectacle of overworked horses dragging cars along the streets is about the most unmechanical sight possible. If the electrical experts will only stop in their exhaustive work of priming the daily press long enough to get their motors in successful operation on a few street lines in New York, the majority of citizens, including the Society for the Prevention of Cruelty to Animals, will bless them. It may, in time, occur to electricians that most people believe there is a good deal more cry than wool in what they say. Talk will not do good service much longer; it will not even boom the stock of electric motor companies.

Those who are earnestly looking for a solution of the so-called "labor problem" may do worse than to look after the outcome of an experiment made by the Minneapolis Knights of Labor. Something more than a year ago they bought a tract of land

upon which 250 extremely poor families settled. They had literally nothing to start with, yet after a year they are beginning to accumulate property, and there is every reason to believe that they will find themselves well to do in a few years.

An item has been going the rounds of the press for some time to the effect that a steel casting made for the Government cruiser Charleston, the casting requiring the melting of 30,000 pounds of steel, was the largest ever made in this country. As a matter of fact several steel castings have been made at the Cambria Iron Works, Johnstown, Pa., weighing 40,000 pounds each.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(336) F. C., Toronto, asks: In what numbers of the AMERICAN MACHINIST can I get full instructions for making blue prints, including the construction of printing frame? *A.*—May 29, July 31 and August 14, 1886.

(337) J. B., Dallas, Tex., and A. W., Newark, N. J., who inquire about ports for small engine cylinders, will find rules for proportioning ports in the AMERICAN MACHINIST of September 5, 1885. These rules will apply to stationary engines as well as to locomotives. Bridges are very commonly made about the same thickness as the metal in the walls of cylinder. To cut off at three-quarter stroke, make the outside lap 1 64 inch less than the width of steam port, and give the valve sufficient travel to just open the steam port. For later cut-off give less outside lap and travel. Give little or no inside lap.

(338) A. B. C., Delano, Pa., writes: Please instruct me how to calculate the strain on a guide; the diameter of the cylinder, length of stroke, steam pressure, length of main rod and position of crosshead being given. *A.*—See last issue and the issue of the AMERICAN MACHINIST of July 23, 1887, pages 2 and 3. What is the pressure of the crosshead against the slides in a locomotive with cylinders 20 inches diameter, 24 inches stroke, 120 pounds steam pressure, main rod 66 inches long? Also the pressure of crosshead against the slides, with the former 8 inches from the end of stroke? *A.*—You did not state the amount of play of axle-box in pedestal; if the center of cylinder is above the driving axle, as is often the case, then this distance should also have been given. In last issue you will find rules given by which a solution of your problem can be obtained.

(339) E. B. M., Millerton, N. Y., writes: Take a Corliss condensing engine, close the throttle, disconnect the steam valves, close the ports, or, in other words, shut off all communication with the boiler, and will the engine continue to run? If so, why? I think it will not run. *A.*—Your conclusion is right. Under the conditions named, after one revolution the pressure, or vacuum, will be the same on each side of the piston, and all the air pumps in the world will have no effect whatever in moving the piston. If the engine would run under these conditions, the question of perpetual motion and power for nothing would be solved. If the throttle and steam valves leak, the engine may run. In that case, the steam that leaks into the end of cylinder which is open to the condenser will be condensed, while that which leaks in the other side will move the piston.

(340) J. F. B., Carbondale, Pa., asks: 1. What is wrong with injectors and inspirators that will prime all right, but as soon as you turn the current of water into the boiler it breaks? *A.*—We cannot tell without knowing the circumstances under which they are used. Judging from the tone of your letter, we believe it is the want of experience in using them. 2. Is castor oil as good to prevent rubber belts from slipping on the pulleys as boiled linseed oil? *A.*—To decide which of the two oils is the best would require a number of experiments with the results tabulated. Tables of this kind we believe do not exist—at least we have not seen any, and therefore cannot positively say which oil is the best for the purpose mentioned. We are of the opinion that the result of using either of these oils is about the same. 3. Is castor oil injurious to rubber belting? *A.*—We believe it is not injurious to rubber belting.

(341) S. A. S., Evansville, Ind., writes: Please let me know if the solution of the following problem is correct: A safety valve has a bevel of 32 degrees, and depth of seat is 1/6 of an inch; the safety valve is to lift 3/8 of an inch; and to give an opening of 1¼ square inches, what should be its diameter? The enclosed drawing shows that 3/8 of an inch lift makes the shortest distance between the face of the valve and that of the seat equal to 5-16 of an inch. And 1¼ square inches of opening = 384 sixteenth inches; 384÷5=76 8, which is the circumference of the valve at the smallest opening in sixteenth inches; 76 8÷16=4.8, which is the circumference in inches; and 4.8÷3.1416=1.52 inches, which is the diameter of the valve. *A.*—You have evidently found the shortest distance between the face of the valve and that of the seat by measurement, and called it 5 16 of an inch; assuming that this is correct, then your answer is also correct. But your manner of obtaining this result is a roundabout way; you could have obtained the same result in the following manner: Divide the required opening by the shortest distance between the face of the valve and that of the seat; the quotient will be the circumference in inches; then dividing this quotient by 3.1416, the diameter of the valve will have been obtained, thus:

1.50÷5-16=4.8, and
4.8÷3.1416=1.52 inches = diameter.

The shortest distance between the face of the valve and that of the seat can be found as follows: Subtract the angle of 32 degrees from 90 degrees, which will leave 58 degrees: then multiply the natural sine of an angle containing 58 degrees by the lift of the valve, namely, ⅜ of an inch; the product will be the distance required. According to this rule, you will find that this distance is a little more than 5-16 of an inch, and consequently the diameter of the valve will be 1.4+ inch, instead of 1.52 inch.

Business Specials

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

New Book for Machinists. See adv., p. 16.

Link-Belting.

Send for catalogue of Link-Belting.

Over 50,000,000 feet of Link Belt in use.

Link-Belt Machinery Co., Chicago and N. Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Air Compressors, Rock Drills. J. Clayton, 43 Dey st., NY

Exhaust Tumbl'g Bbls. Henderson B's., Waterb'y, Ct.

Upright Drills from 20" to 36" inclusive. Currier & Snyder, Worcester, Mass.

For Improved Cooper Stoves, send to Variety Machine Co., Warsaw, N. Y.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y

Solid Nickel-Seated "Pop" Safety Valves. Consolidated Safety Valve Co., 111 Liberty st., Y. N.

Robbs' Patent Composition for case-hardening. Send for circular. F. W. Tasney, Paterson, N. J.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Injectors, Ejectors, Oil Cups, Sight Feed Lubricators, etc. Arthur Appleton, 45 Cortlandt st., N.Y.

For Sale—Very successful single-valve automatic Governor Patent. Address Patent, AM. MACHINIST.

Ice and Refrigerating Machines. 124 built and all successful. David Boyle, 521 Monroe St., Chicago, Ill.

Drawing Materials, all kinds. Get catalogue. Mention this paper. G. S. Woolman, 116 Fulton st., N. Y.

The Improved Tabor Steam Engine Indicator, made and sold by The Ashcroft Mfg. Co., 111 Liberty st., N. Y.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large; prices low. Frasse & Co., 92 Park row, N. Y.

Machinists' supplies, brass goods, m'f'rs' supplies, polishing materials, all kinds wire, metals, etc.; in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N.Y. Send for des'n.

Curtis Pressure Regulators, Curtis Return Trap, Curtis Damper Regulator. See July 16, p. 14. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Press for sale. Quick-acting; hole in bed, 8x5 punches to center of 13-inch sheet; 2¼-inch shaft; also four-spindle Drill. B. W. Payne & Sons, Elmira, New York.

Reed's Engineer's Hand-Book to the Local Board Examinations. Eleventh edition revised and enlarged, with 260 diagrams and 36 large plates. 8vo., cloth, $4.50, post-paid. Catalogue of books free. E. & F. N. Spon, 35 Murray st., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2 post-paid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

Manufactures.

Water-works will be built at Bessemer, Ala.

Columbus, Ohio, requires new pumping engines.

I. M. Watson & Co. will build a flouring mill at Tallapoosa, Ga.

The Stillwater (Minn.) Gas Company will put in a new $18,000 plant.

A 2,000,000-gallon pumping engine will be put in at Newburgh, N. Y.

The Wellston (Ohio) Foundry and Machine Works will build a new foundry.

The Missouri Pacific Railroad shops at Dennison, Tex., are being enlarged.

Murray & Stevenson, Anniston, Ala., will double the capacity of their foundry.

Frank Field is secretary of the Oak Cliff Water Supply Company, of Dallas, Tex.

J. S. Hill is interested in building a saw mill and a flouring mill at Brighton, Tenn.

The Catonsville (Md.) Water Company expect to increase their capital stock to $60,000.

G. P. Droomgoole is secretary of the new Safe and Lock Company, of Birmingham, Ala.

The Anniston Ice Company, Anniston, Ala., will put in new machinery of greater capacity.

Fire at Baton Rouge, La., has destroyed the Baton Rouge Foundry. Insurance, $18,500.

A cotton-seed oil mill and a guano factory are to be built at Cuthbert, Ga., by Rauls & Perry.

F. C. & V. P. Travers will build a large brick factory at 518 to 528 West Fifty-second street.

A grain elevator is to be built at Norfolk, Va., by the Norfolk and Western Railroad Company.

Fred. Kehoe will build a brick workshop on 124th street, north side, near First avenue, N. Y. City.

At Ord, Neb., the vote has been in favor of issuing bonds to cover the expense of building water-works.

The Fergus Falls (Minn.) Electric Light Company have elected officers, and will commence work with $15,000 capital stock.

Charles P. Maxwell has nearly completed his new foundry at Lisbon Falls, Me., and will be ready for business early in August.

A saw mill and planing mill are to be built at De Soto, Ga., by the Americus Land and Lumber Company, of Americus, Ga.

The grain elevator of the C. A. Gambrill Manufacturing Company, of Baltimore, Md., recently destroyed by fire, will be rebuilt.

The foundry and machine shop of J. C. Bocage & Co., Pine Bluff, Ark., have been leased by George M. Dilley & Son. They will enlarge both.

The Moore Manufacturing Company, of Phœnix, N. Y., have received a boat-load of machinery from Syracuse, and are putting it in place.

The Fort Payne Land and Improvement Company, of Kansas City, Mo., own 36,000 acres of mineral land, and will erect iron and steel works and coke ovens.

W. E. Crane, Waterbury, Conn., has devised a simple arrangement for drawing ellipses, which he will probably put on the market. It is both simple and inexpensive.

A charter has been obtained by the Reading Steam, Heat and Power Company at Reading, Pa The capital is $100,000, one-tenth of which was paid in before the charter was issued.

The trouble over the water supply at Mount Holly, N. J., has culminated in the formation of a syndicate for the erection of new water-works to secure purer water than that now furnished.

St. Cloud, Minn., will have a new flouring mill, five stories high, and will give $6,000 bonus and a site. Capacity to be 350 barrels a day, with facilities to increase output to 600 barrels when necessary.

Sebastian May & Co., engine lathe builders at Cincinnati, Ohio, have removed to their large four-story brick shop, just completed. This gives them much greater capacity, which their increasing business demanded.

W. L. Atkinson, Philadelphia, Pa., will build a foundry, 50x125 feet, on Thirty-second street, below Vine street, Philadelphia; also a paper mill, 43x140 feet, three stories, on Twenty-fourth street, above Vine street.

Large deposits of clay at Austin, Minn., have been found valuable, and $10,000 worth of machinery will be put in and manufacturing begin soon. The new water-works at Austin are to cost $40,000. Austin is doing well.

The Cleveland Stone Company have bought the Quinnebaug scythe-stone ledge at West Cummington, Mass., with the shops and the valuable water-power connected, and will carry on the manufacture of whetstones on a large scale.

The Beckett & McDowell Manufacturing Company have issued a circular to the effect that their plant has been materially enlarged, and that they have arranged to have their main office with the works, under one management, at Arlington, N. J.

The South Baltimore Car Company has been organized at Baltimore, Md. They are building works at Curtis Bay, six miles from Baltimore. It is expected the works will be in operation by fall. The capacity of the works will be from eight to twelve cars per day.

Steps, such as the organization of a new company embracing several Madison citizens, are being taken looking toward the erection of a new woolen mill in Madison, Me. A dam across the Kennebec is contemplated, and a site for the mill has been cleared on the island.

Some of the officers of the Williston & Knight Button Company, of Easthampton, Mass., have bought the ivory button business of the Bostwicks, of Middletown, Conn., and the two will be run in connection. Some of the Mill River Button Company's machinery will go down there.

The *National Labor Tribune*, of Pittsburgh, Pa., says: "It is reported that the National Tube Works Company, of McKeesport, Pa., will erect at an early date another rolling mill adjacent to the one completed some time ago. A tract of land at that point has been purchased by the company."

C. H. Carpenter, Kansas City, Mo., is interested in building a large tool and implement manufactory, the manufacture to comprise all kinds of tools and implements used on a farm—from a traction engine down. Land has been bought within five miles of Kansas City upon which to build works.

The Forest Fiber Company, Berlin Falls, N. H., own a very valuable water-power adjacent to their own, for which an offer of $30,000 has been refused, the owners deliberating whether to enlarge their own operations or reserve it for the site of a cotton or woolen mill, for which it is admirably adapted.

H. M. Jones is drawing the plans for the new orguinette factory at Meriden, Conn., previously noted, which is to be situated south of the organ shop. It is to be 150 feet on both Cambridge and Tremont streets, four stories high, of brick, and 50 feet wide. The plans call for a splendid-looking building.

The Powell Machine Tool Company, Worcester, Mass., has surrendered its charter, and the Powell Planer Company has been incorporated at the same place, under the laws of Massachusetts. The management will be under the control of A. M. Powell, of the old company, and E. M. Woodward, formerly with E. P. Bullard.

F. Englehart, A. E. Foth and O. Knab, Springfield, Mass., under the style of the Englehart Elevator Company, have taken out patents for a new elevator, and will soon begin manufacturing them. They have, in fact, made one, and have another in process of construction. The manufacturing will be done in Springfield.

In connection with the project previously noted of starting a new town on its line, it is stated that the New York, New Haven and Hartford Railroad will build at once 100 passenger cars, 20 drawing-room coaches, and 6 engines to use hard coal. The engines will be constructed in shops other than the company's, and will be completed at the earliest moment.

The granite foundation of the main building for the Beattie Zinc and Electric Company, Fall River, Mass., has been completed. The walls will be of brick. The building will be completed probably by August 10th. The smelting furnace will be located in the center of the foundry, where a chimney 60 feet high will be erected. The contractor is Joseph M. Darling, the architect.

The plans and specifications for the Hydraulic Company's stand-pipe at Grand Rapids, Mich., have been completed, and the contract for construction will be let soon. It will be 165 feet above the low-water mark at Fountain street bridge. The contract will be let probably this week for the erection of the engine house north of the city, and the large well from which the supply will be enlarged and improved. The work of laying the water pipes will be pushed as rapidly as possible.

The Globe Iron Works Company, Cleveland, are already engaged in enlarging their yard and putting in a large amount of new machinery. Part of the timber is on the ground for a new building on 300 feet river front secured adjoining their present shipbuilding yard. The building will be 160 feet long, 48 feet wide, and will probably be complete within thirty days. When finished it will be furnished with a complete new outfit of tools and machinery.

The Kansas City (Mo.) Switch and Frog Company, just organized, completed arrangements the past week with the Blue Valley Land Company, and will erect on the grounds of the company works to cost $100,000 The Land Company donated to the Frog Company six acres of land for the purpose. The company is the outgrowth of the Armourdale Frog and Switch Company, and all the machinery of the Armourdale Works will be removed to Manchester. The works now employ 75 men, but the new works will employ over 600 hands. J. H. Chickering is secretary, and can give information. —*Industrial Gazette.*

The Kansas City *Commercial* says of the McMillan Car Works at Minnaville, Mo., which we have previously noticed: "The McMillan Car Works, at Minnaville, will be one of the largest in the country. The size of the car-wheel foundry building will be 85x221 feet. The roof will be supported by double trusses, doing away with the necessity of posts, and affording more room on the floor below. The size of this building will admit of eight floors, with a capacity of 200 wheels per day. The other building will be devoted to the manufacture of soft castings, and will be 65x150 feet. A huge crane, with a diameter of 100 feet, will be placed between the two foundry buildings to hoist iron from and to the railroad tracks and buildings. Overhead tracks will be used to gather the mouldings throughout the foundries and transfer to the railroad tracks."

Machinists' Supplies and Iron.

NEW YORK, July 28, 1887.

Iron—There is as yet scarcely a demand for forward delivery of American pig, but inquiries for prices for such delivery are more common. Prices remain substantially stationary. We quote for standard brands No. 1 X Foundry, $21 to $21.50; No. 2 X, $19.50 to $20.50; Grey Forge, $17.50 to $18.50.

Scotch Pig—Sales of Scotch brands are slow, but prices are still firm in Glasgow. Sales have been made of Coltness, $22.50 to $23: Gartsherrie, $21.50 to $22; Summerlee, $21.50 to $22: Eglinton, $20.50 to $21; Dalmellington, $20.50 to $21.

Antimony—Hallett's, 8¼c; Cookson's, 9c.

Copper—Lake has sold at 10.70c.; casting brands, 9¾c.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate, 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Competent machine shop foreman wants engagement; any class of machinery. Address Box 45, AM. MACHINIST.

Wanted—Situation as draftsman by technical graduate. Address N., care European Hotel, Chattanooga, Tenn.

Wanted—An engagement by a technical graduate with some experience in developing special machinery and a determination to succeed. Address F. G., AM. MACHINIST.

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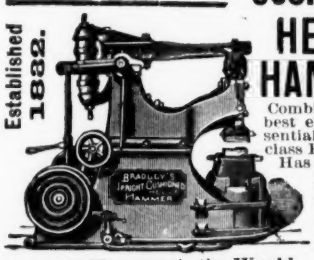

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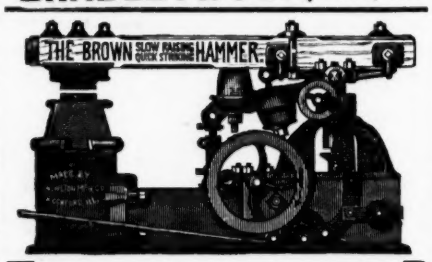

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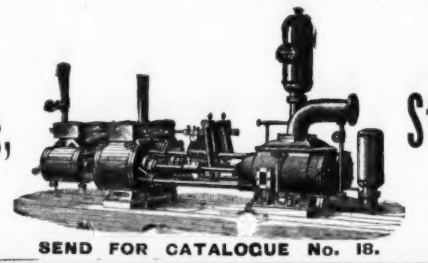

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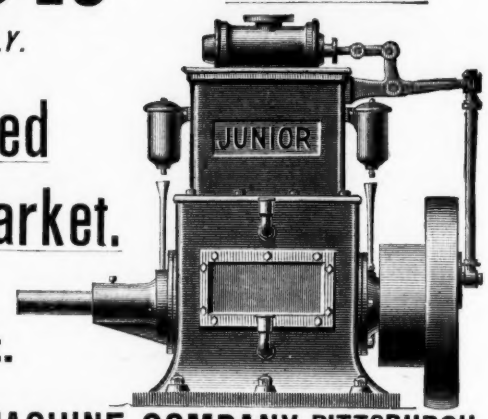

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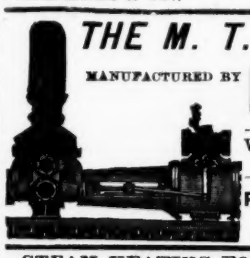

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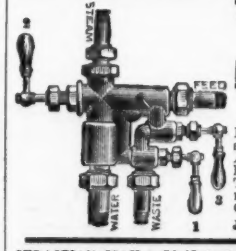

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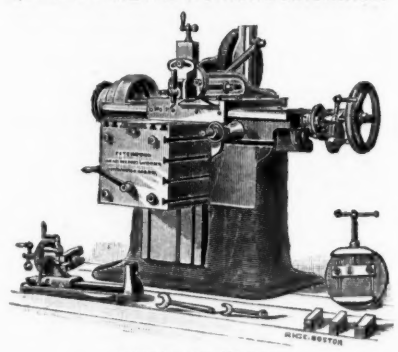

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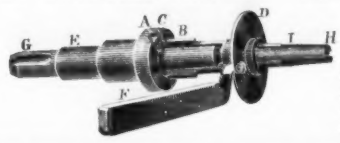

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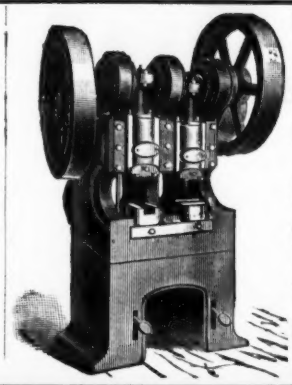

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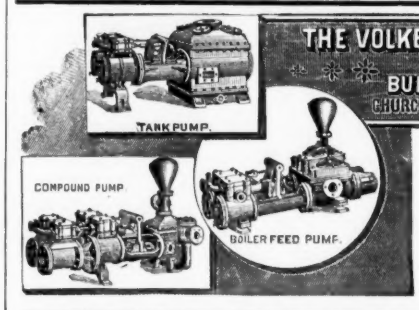

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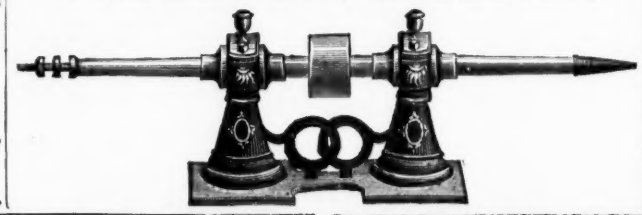

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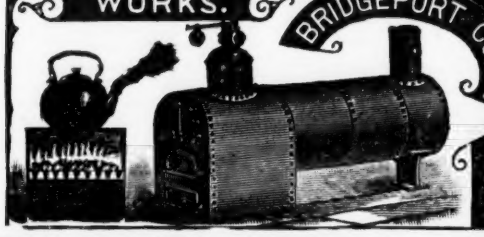
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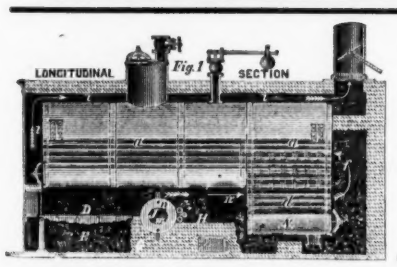

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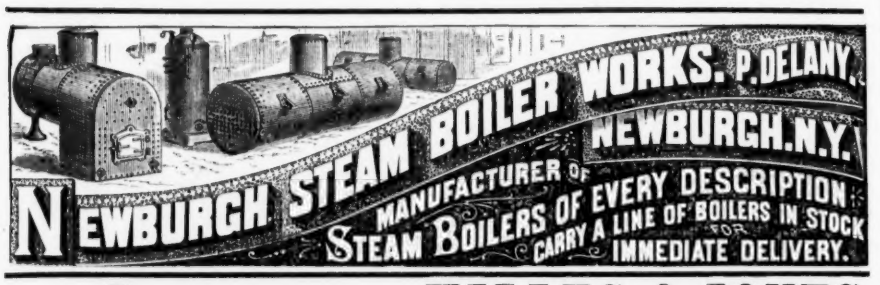
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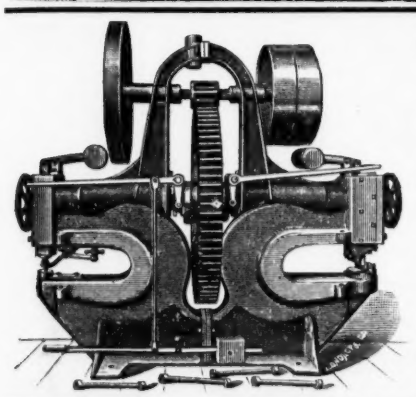
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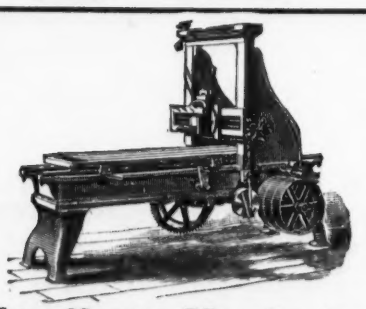
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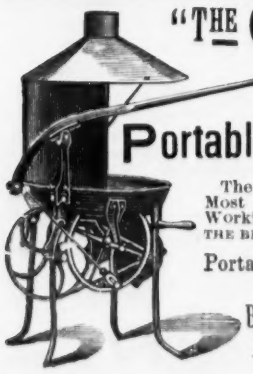
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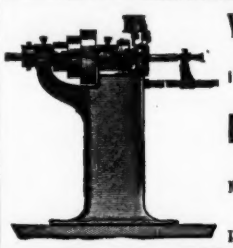
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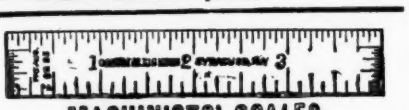
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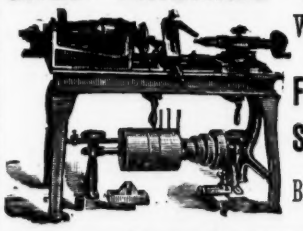
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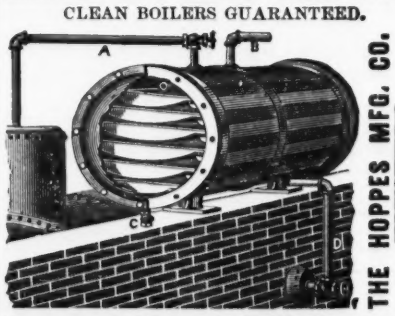

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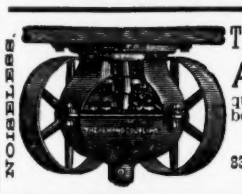
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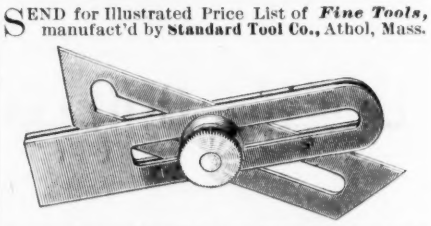
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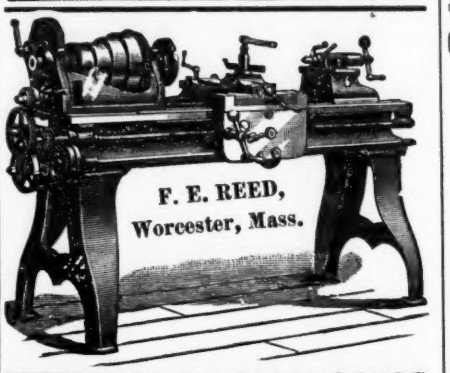

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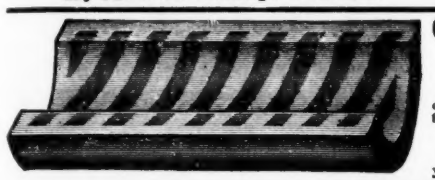

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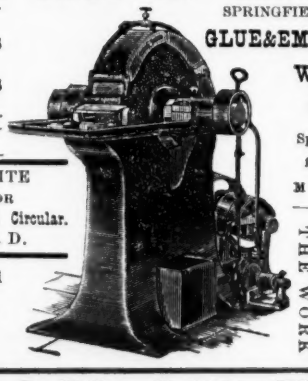

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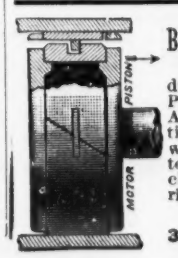

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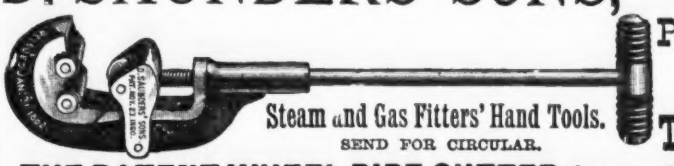

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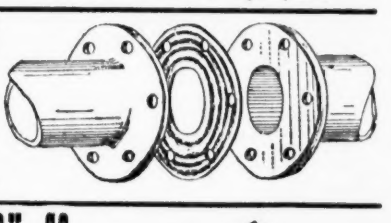

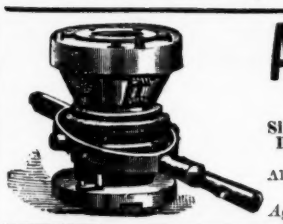

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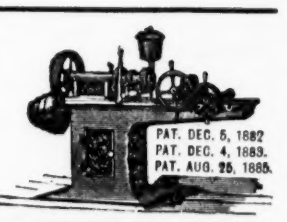

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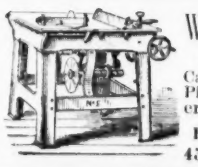

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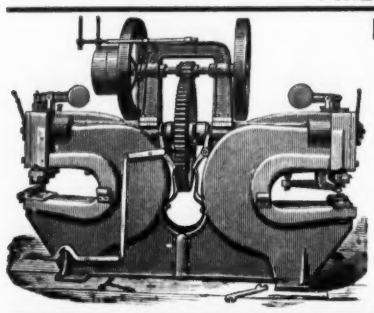

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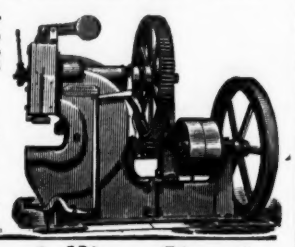

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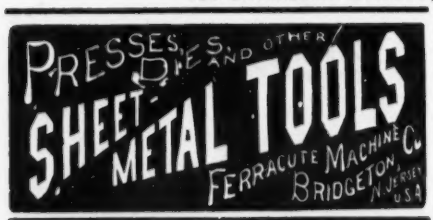

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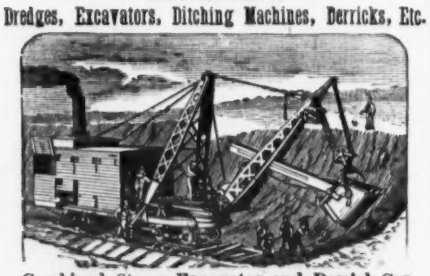

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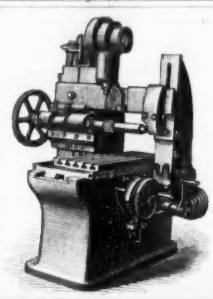

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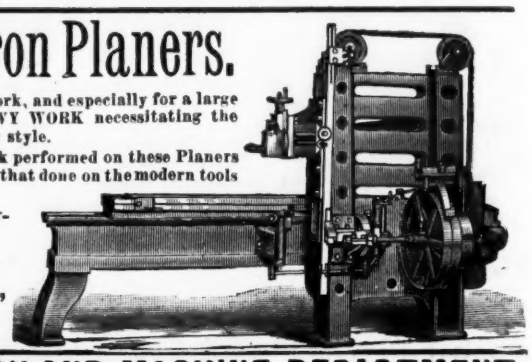

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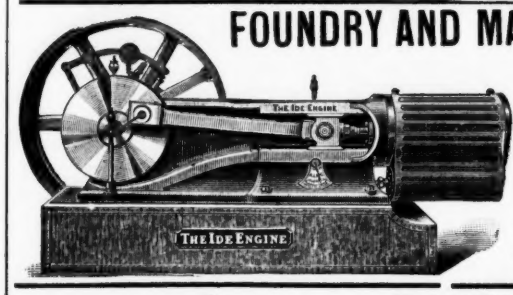

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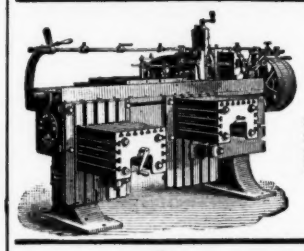

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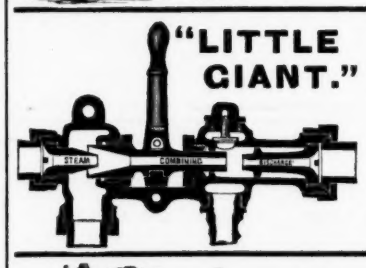

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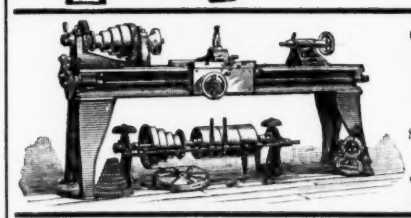

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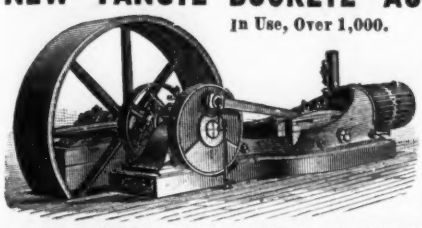

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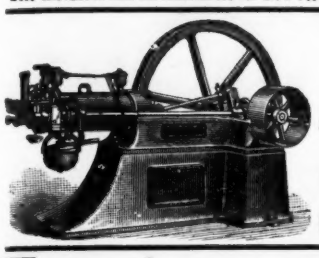

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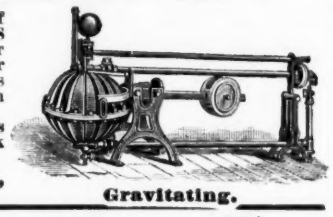

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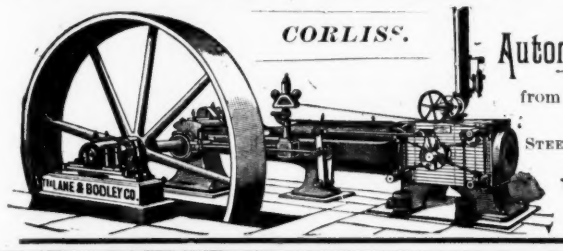

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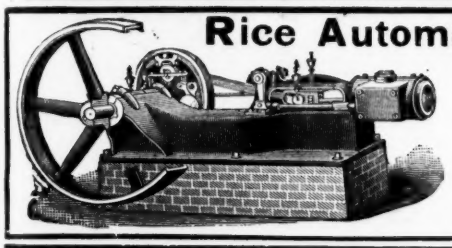

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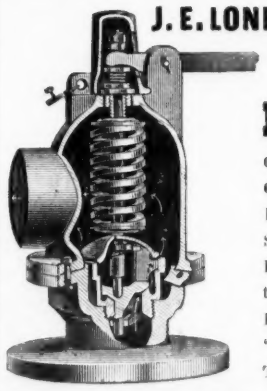

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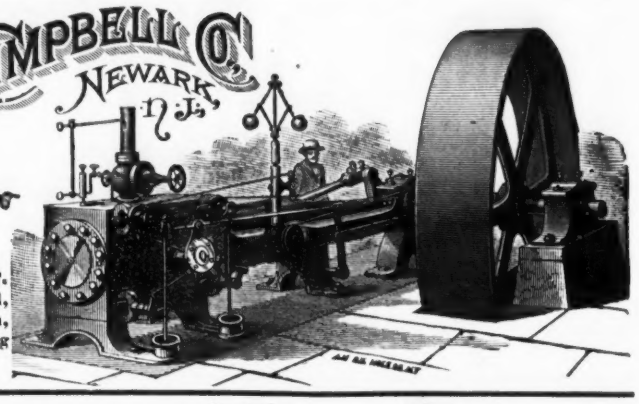

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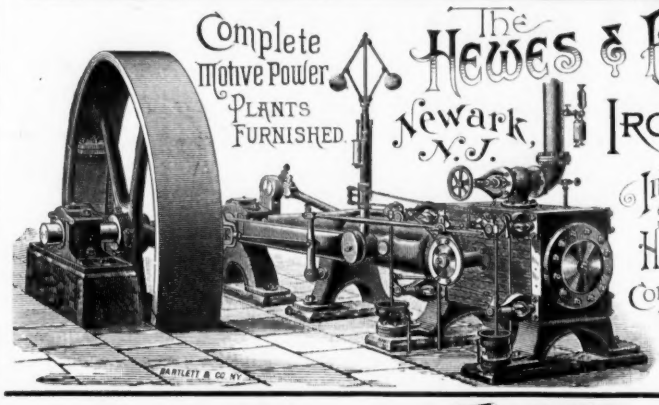

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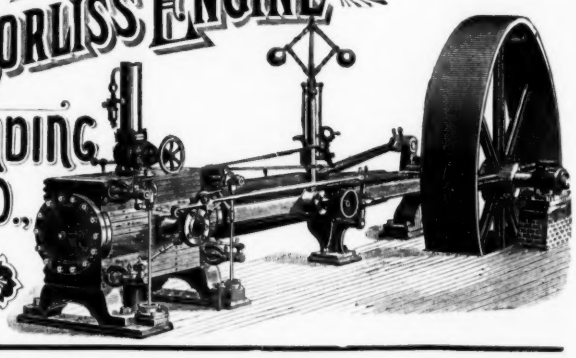

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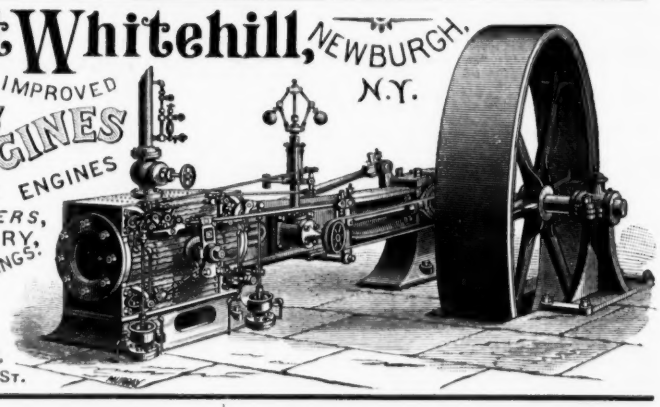

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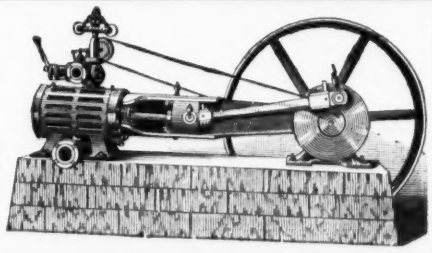

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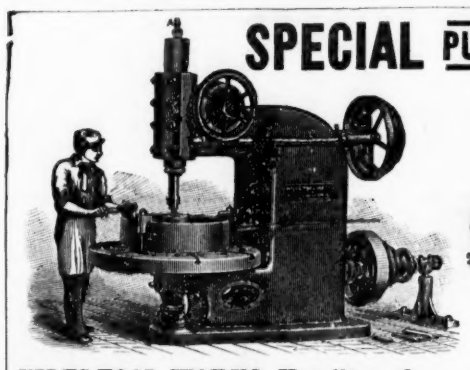

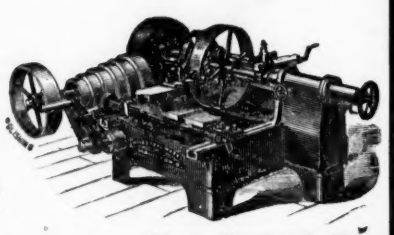

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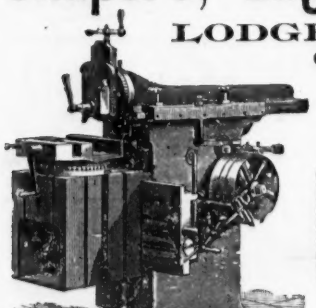

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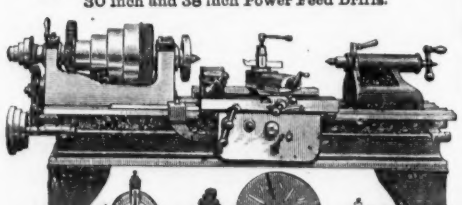

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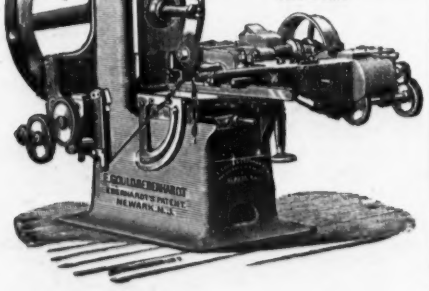

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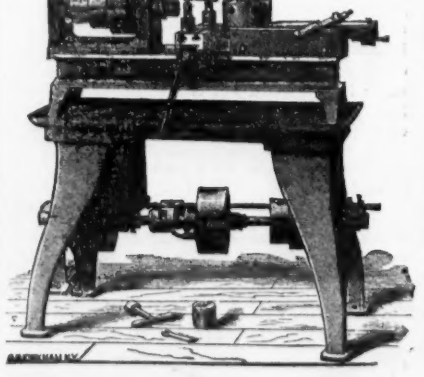

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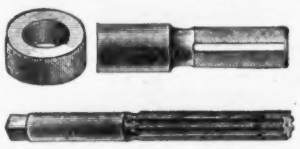

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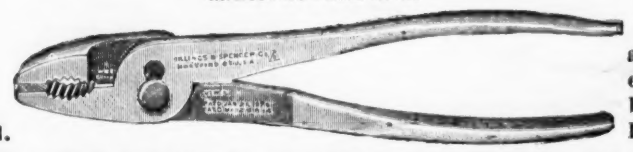

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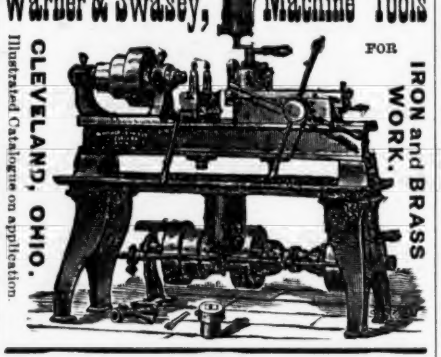

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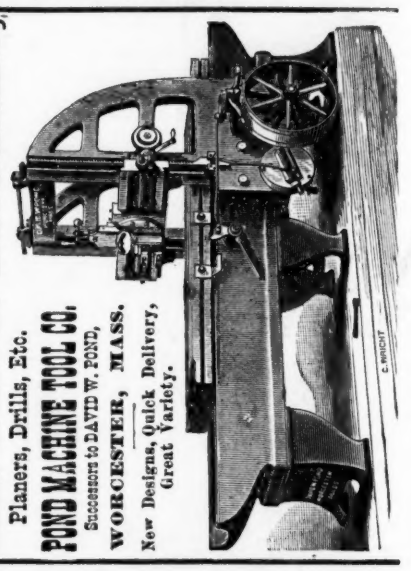

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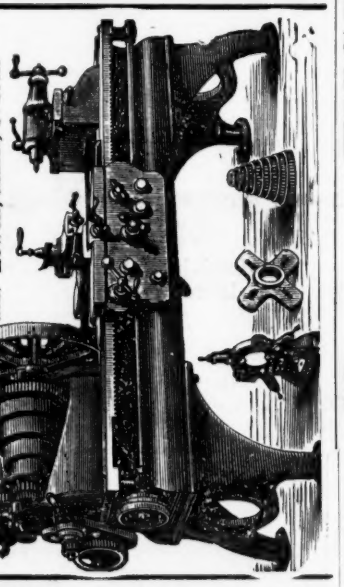

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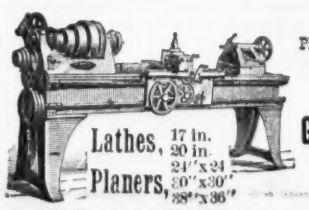

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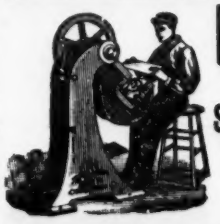

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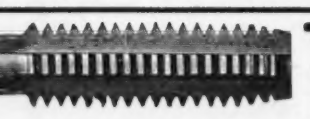

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